

(19)日本国特許庁 (J P)

(12) 公 開 特 許 公 報 (A)

(11)特許出願公開番号  
特開2003-142131  
(P2003-142131A)

(43)公開日 平成15年5月16日(2003.5.16)

(51)Int.Cl.<sup>7</sup>

識別記号

F I

テーマコード(参考)

H 0 1 M 8/04

H 0 1 M 8/04

C 4 D 0 4 8

H 4 G 0 6 9

J 5 H 0 2 6

N 5 H 0 2 7

B 0 1 D 53/86

B 0 1 J 35/04

3 0 1 A

審査請求 未請求 請求項の数23 O L (全 16 頁) 最終頁に続く

(21)出願番号 特願2002-15128(P2002-15128)  
(22)出願日 平成14年1月24日(2002.1.24)  
(31)優先権主張番号 特願2001-253247(P2001-253247)  
(32)優先日 平成13年8月23日(2001.8.23)  
(33)優先権主張国 日本 (J P)

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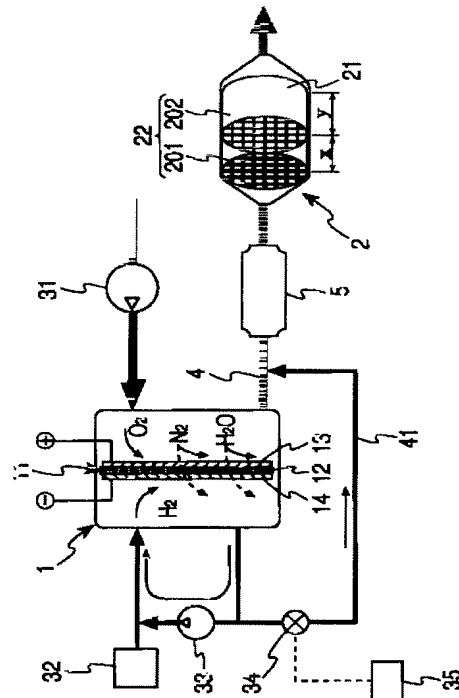
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(54)【発明の名称】 燃料電池の排出水素処理装置

(57)【要約】

【課題】 燃料電池から排出されるガス中の水素を、安全かつ迅速に処理することのできる排出水素処理装置を提供する。

【解決手段】 固体高分子電解質膜12を挟んで水素極13と空気極14を配置してなる燃料電池1において、水素極13から排出される水素を含む排出ガスを、空気極14から排出される酸素を含む排出ガスを支燃ガスとして、排出水素処理装置2に導入し触媒燃焼させる。触媒体22は、ガス中の水素濃度が高い上流側触媒体201の通路壁211厚さを、下流側触媒体202の通路壁212より厚くして、単位体積当たりの熱容量を高めているので、過昇温が抑制され、触媒体22全体を、安全かつ効率よく触媒燃焼可能な温度に保持できる。



## 【特許請求の範囲】

【請求項1】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、導入されるガス中の水素濃度分布に応じて上記触媒体の構造を変更することを特徴とする燃料電池の排出水素処理装置。

【請求項2】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体を、導入されるガス中の水素濃度が高い部位の、単位体積当たりの熱容量が、他の部位よりも高くなるように構成したことを特徴とする燃料電池の排出水素処理装置。

【請求項3】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体を、導入されるガス中の水素濃度が高い部位の、単位体積当たりの発熱量が、他の部位よりも小さくなるように構成したことを特徴とする燃料電池の排出水素処理装置。

【請求項4】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体を、導入されるガス中の水素濃度が高い部位の、単位体積当たりの触媒の担持面積が、他の部位よりも小さくなるように構成したことを特徴とする燃料電池の排出水素処理装置。

【請求項5】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体を、導入されるガス中の水素濃度が高い部位の、単位面積当たりの触媒担持量が、他の部位よりも少なくなるように構成したことを特徴とする燃料電池の排出水素処理装置。

【請求項6】 上記触媒体が、ハニカム構造の担体に触媒を担持してなり、上記導入されるガス中の水素濃度が高い部位の、上記担体の通路壁の厚さを、他の部位よりも厚くした請求項1ないし5のいずれか記載の燃料電池の排出水素処理装置。

【請求項7】 上記触媒体が、ハニカム構造の担体に触媒を担持してなり、上記導入されるガス中の水素濃度が高い部位の、上記担体の通路断面積を大きくした請求項1ないし5のいずれか記載の燃料電池の排出水素処理装置。

【請求項8】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体を、導入されるガス中の水素濃度が急激に低下した部位の、単位体積当たりの水素処理能力が、他の部位よりも大きくなるように構成したことを特徴とする燃料電池の排出水素処理装置。

【請求項9】 上記触媒体が、ハニカム構造の担体に触媒を担持してなり、上記導入されるガス中の水素濃度が急激に低下した部位の、単位面積当たりの触媒担持量が、他の部位よりも多い請求項8記載の燃料電池の排出水素処理装置。

【請求項10】 上記触媒体が、ハニカム構造の担体に触媒を担持してなり、上記導入されるガス中の水素濃度が急激に低下した部位の、単位体積当たりの触媒の担持面積が、他の部位よりも大きい請求項8記載の燃料電池の排出水素処理装置。

【請求項11】 上記触媒体をセラミック製または金属製のハニカム構造の担体を用いて構成する請求項1ないし10のいずれか記載の燃料電池の排出水素処理装置。

【請求項12】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体をガス流れの方向に複数に分割し、上流側にセラミック製の担体を用いた触媒体を配置するとともに、その下流側に金属製の担体を用いた触媒体を配置することを特徴とする燃料電池の排出水素処理装置。

【請求項13】 上記触媒体の設置位置を、上記空気極からの排出ガスを大気への放出するための排出通路内とした請求項1ないし12のいずれか記載の燃料電池の排出水素処理装置。

【請求項14】 上記触媒体の設置位置を、上記空気極

からの排出ガスを大気への放出するための排出通路内で、かつ大気への放出口の近傍とした請求項1ないし12のいずれか記載の燃料電池の排出水素処理装置。

【請求項15】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記水素極側から排出される水素を含む排出ガスを上記触媒体に導くための水素排出通路と、上記水素排出通路を開閉する開閉手段と、上記開閉手段の開閉を制御し、上記水素排出通路を定期的に開放して上記水素を含む排出ガスを上記触媒体に導入する制御手段を設け、上記制御手段は、上記触媒体の予熱期間中、上記開閉手段の開閉を短時間に繰り返して間欠的に上記水素を含む排出ガスを導入する制御を行うことを特徴とする燃料電池の排出水素処理装置。

【請求項16】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体に、上記水素を含む排出ガスを導入するための通路を設けるとともに、該通路を、上記触媒体の各部位が所望の発熱量となるように、上記触媒体のガス流れ方向の複数箇所に上記水素を含む排出ガスを分割して導入する構造としたことを特徴とする燃料電池の排出水素処理装置。

【請求項17】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体に、上記水素を含む排出ガスを導入するための通路を設けるとともに、該通路に、上記触媒体のガス流れ方向の複数箇所に上記水素を含む排出ガスを分割して導入する複数の分岐路を設け、かつこれら複数の分岐路を、対応する上記触媒体の各部位が所望の発熱量となるように構成したことを特徴とする燃料電池の排出水素処理装置。

【請求項18】 固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体に、上記水

素を含む排出ガスを導入するための通路を設けるとともに、該通路に、上記触媒体のガス流れ方向の複数箇所に上記水素を含む排出ガスを分割して導入する複数の分岐路を設け、かつこれら複数の分岐路を、上記触媒体のガス流れ方向の上流側に下流側よりも多くの上記水素を含む排出ガスが導入される構造としたことを特徴とする燃料電池の排出水素処理装置。

【請求項19】 上記複数の分岐路の流路断面積を変えて、上記触媒体のガス流れ方向の上流側に下流側よりも多くの上記水素を含む排出ガスが導入されるようにした請求項18記載の燃料電池の排出水素処理装置。

【請求項20】 上記複数の分岐路の端部に設けられ、上記触媒体の各部位に上記水素を含む排出ガスを導入するための導入口の開口面積または数を変更して、上記触媒体のガス流れ方向の上流側に下流側よりも多くの上記水素を含む排出ガスが導入されるようにした請求項18記載の燃料電池の排出水素処理装置。

【請求項21】 上記複数の分岐路への上記水素を含む排出ガスの流入を制御する流路切替手段を設け、燃料電池の発電時には、上記触媒体のガス流れ方向の上流側に、上記水素を含む排出ガスのほぼ全量が導入され、発電停止時または起動時には、上記触媒体のガス流れ方向の下流側にも、上記水素を含む排出ガスが導入されるように、流路切替を行う請求項18記載の燃料電池の排出水素処理装置。

【請求項22】 上記触媒体の、ガス流れ方向の前面に、発泡金属よりなる気液分離部材を設けた請求項1ないし21のいずれか記載の燃料電池の排出水素処理装置。

【請求項23】 上記気液分離部材のガス流れ方向の前面に、凝縮水が存在しやすい部位を覆う遮蔽部材を設けた請求項22記載の燃料電池の排出水素処理装置。

【発明の詳細な説明】

【0001】

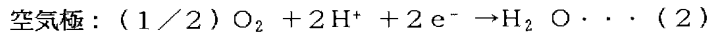
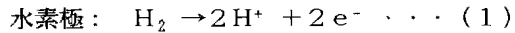
【発明の属する技術分野】本発明は、家庭用あるいは自動車用発電機等に好適に用いられ、水素と酸素の化合反応を利用して電気を取り出す燃料電池から排出される水素を処理するための水素処理装置に関する。

【0002】

【従来の技術】近年の環境汚染や地球温暖化といった問題に対応するために、低公害の代替エネルギー車として、電気自動車が目ざされている。例えば、蓄電池を搭載した電気自動車が既に実用化の段階に入っているが、蓄電池式車両は、電池の蓄電能力との関係で、走行距離が比較的短く、また、充電時間が長い等の問題があり、汎用化の妨げとなっている。このため、これら問題を解消し得る電気自動車として、燃料電池式車両の開発が急務となっている。

【0003】燃料電池は、一般に、高分子膜を挟んで水素極と空気極を配置した単位セルを有し、水素極に水素

を含む燃料ガスを、空気極に空気を供給して発電を行うものである。この時、両極では、それぞれ下記式



【0004】ところが、燃料電池を車両に搭載する場合、つまり移動式燃料電池では、設置式燃料電池においてさほど問題とならなかったことが大きな問題となる場合がある。その1つに、純水素を搭載する燃料電池から排出される水素の処理が挙げられる。これは、燃料電池で発電する際に発生する水や、空気極で使用する空気中の窒素の一部が、高分子膜を通過して水素極側に混入すると、水素濃度を低下させるということに起因している。そこで、混入した不純物を排出する必要が生じ、その一例として、一定時間毎に水素極側のガスを水素で置換する方法がある。この場合、置換により排出されるガス中には可燃性の水素が含まれるため、そのまま大気中に放出することは好ましくなく、何らかの処理が必要となっている。

【0005】ここで、水素を含む混合ガスの処理方法としては、従来、分析計等において水素透過膜を用いることにより（または混合ガス中の他の成分である窒素を分離するための窒素透過膜を用いることにより）、水素を分離回収する方法がある。また、水素を無害化して排出する一般的な方法として、バーナーを付設して燃焼により水素を除去する方法が考えられる。

【0006】

【発明が解決しようとする課題】しかしながら、燃料電池から排出されるガス量は、分析計等が扱う量に比べると桁違いに多く、圧力損失が増大して動力が増大する問題がある。また、バーナーを付設する方法は、バーナーで高温燃焼することにより、 $\text{NO}_x$ が発生する問題があり、より安全かつクリーンに排出水素を処理する方法が要求されている。

【0007】また、発電時には、燃料電池から排出されるガス中に、水分が多量に含まれる。一方で、運転状態によっては水分を含まない、より高濃度で多量の水素を含むガスが排出されることがある。例えば、水素を燃焼させて処理した時に、水分を多量に含むガスに比べて水分を含まないガスは燃焼しやすいため、温度が上昇し過ぎるおそれがある。

【0008】そこで、本発明は、純水素を燃料とする燃料電池において、燃料電池から排出されるガス中の水素を、大気中にそのまま放出することなく、安全かつ迅速に処理することができ、さらに、運転状態に応じて排出ガス中の水素や水分量が変動しても、過昇温等の不具合が生じない排出水素処理装置を提供することを目的とする。

【0009】

【課題を解決するための手段】本発明は、車両用のような移動式燃料電池で、水素ガスをタンクや吸蔵合金とい

(1)、(2)で表される反応が生じる。

った貯蔵手段に蓄えて搭載するタイプの燃料電池において、水や窒素が混入して発電に使用できなくなった水素を含む排出ガスを、安全に処理するための簡素な装置を提案するものである。そして、燃料電池の空気極側から排出される排出ガスには、水素極側から排出される水素を含む排出ガスを酸化するに十分な酸素が含まれることや、水素は常温で触媒燃焼可能であることから、酸素を支燃ガスとして触媒燃焼させる処理装置が有効であることを見出した。その際、水素は燃焼速度が非常に速く、その反応速度は温度に大きく依存すること、そのため、触媒と接した直後に急速に反応が進み、水素濃度が急激に低下した後、緩やかに低下を続ける指数関数的な反応を生じること注目した。さらに、湿った触媒表面を乾燥させながら反応を維持するためには、所定の水素量が必要であるとともに、触媒温度が、水分の少ない乾燥したガスの排出時よりも低下することに着目して、運転状態に応じた最適な触媒体構成および水素排出通路構成を検討し、以下の手段を備える本発明に到達した。

【0010】すなわち、本発明請求項1は、固体高分子電解質膜を挟んで水素極と空気極を配置し、水素極に水素ガスを、空気極に空気を供給して発電を行う燃料電池において、上記水素極側から排出される水素を含む排出ガスを処理するための装置を提案するものである。この装置は、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、導入されるガス中の水素濃度分布に応じて上記触媒体の構造を変更することを特徴とするものである。

【0011】上記構成によれば、上記触媒体を用いて水素を触媒燃焼させるので、バーナーで高温燃焼する場合のように $\text{NO}_x$ が発生することがない。また、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして利用するので、新たな支燃ガス供給装置が不要である。さらに、上記触媒体内の水素濃度分布は、一定ではなく、通常、触媒入口部で最も高く、温度上昇しやすいので、例えば、この部位で発生する熱を吸収し、または、発熱を抑制するように、水素濃度分布に応じて上記触媒体の構造を変更すれば、局所的な温度上昇を防止することができる。よって、簡素な構成で安全に効率よく水素を処理することができる。

【0012】上記課題を解決するための他の構成として、請求項2の装置は、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えており、上記触媒体を、導入されるガス中の水素濃度が高い部位における体積当たりの熱容量が他の部位よりも高くなるように構

成している。

【0013】上記したように、上記触媒体内の水素濃度分布は、通常、触媒入口部で最も高く、温度上昇しやすいので、この部位の熱容量を他の部位より高くすれば、触媒表面で発生した熱を吸収して、触媒体の部分的な過昇温を防止することができる。よって、簡素な構成で安全に効率よく水素を処理することができる。

【0014】上記課題を解決するための他の構成として、請求項3のように、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を設けるとともに、上記触媒体を、導入されるガス中の水素濃度が高い部位における、単位体積当たりの発熱量が、他の部位よりも小さくなるように構成することもできる。

【0015】上記構成によれば、上記触媒体内の水素濃度が高く、急激な温度上昇が起きやすい部位の発熱量を小さくすることで、同様に、触媒体の部分的な過昇温を防止することができる。よって、簡素な構成で安全かつ高効率な水素処理装置が得られる。

【0016】上記課題を解決するための他の構成として、請求項4のように、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を設けるとともに、上記触媒体を、導入されるガス中の水素濃度が高い部位における、単位体積当たりの触媒の担持面積が、他の部位よりも小さくなるように構成することもできる。

【0017】上記構成によれば、上記触媒体内の水素濃度が高く、急激な温度上昇が起きやすい部位の触媒担持面積、すなわち発熱面積を小さくすることで、同様に、触媒体の部分的な過昇温を防止することができる。よって、簡素な構成で安全かつ高効率な水素処理装置が得られる。

【0018】または、請求項5のように、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を設けるとともに、上記触媒体を、導入されるガス中の水素濃度が高い部位の、単位面積当たりの触媒担持量が、他の部位よりも少なくなるように構成することもできる。このようにしても、発熱量を小さくして触媒体の部分的な過昇温を防止する同様の効果が得られる。

【0019】具体的には、請求項6のように、上記触媒体を、ハニカム構造の担体に触媒を担持した構成として、上記導入されるガス中の水素濃度が高い部位における、上記担体の通路壁の厚さを、他の部位よりも厚くする。これにより、この部位の熱容量が大きくなり、また、触媒の担持面積も小さくなるので、発熱量自体が低減し、上記効果を容易に得ることができる。

【0020】あるいは、請求項7のように、上記触媒体を、ハニカム構造の担体に触媒を担持した構成として、上記導入されるガス中の水素濃度が高い部位における、

上記担体の通路断面積を大きくしてもよい。このようにすると、触媒の担持面積が小さくなり、発熱量が低減するので、上記効果を容易に得ることができる。

【0021】請求項8の装置では、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を設けるとともに、上記触媒体を、導入されるガス中の水素濃度が急激に低下した部位における、単位体積当たりの水素処理能力が、他の部位よりも大きくなるように構成する。

【0022】上記触媒体内の水素濃度分布は、通常、触媒入口部で最も高く、急速に反応が進んで急減するが、その後は緩やかに低下を続ける。そこで、水素濃度がゆっくり減少する部位の処理能力を高めれば、触媒体のガス流れ方向の長さを短くでき、小型化が図れる。また、通常の処理能力では、水素の流れ始め、つまり触媒温度が低くて活性が低い時に、水素が十分に反応しないまま排出されるおそれがあるが、処理能力の高い部位を設けることで、排気エミッションの悪化を防止することができる。しかも、定常時には水素濃度分布の低い部位であるので、処理能力を高くしても、必要以上に反応熱が発生して過昇温となることがない。逆に、立ち上がり時には、この部位で反応が進みだせば、その輻射および伝熱にて上流側の触媒入口部が活性化するので、部分的な過昇温を抑制しつつ触媒全体を活性化して効率よく処理することができる。

【0023】具体的には、請求項9のように、上記触媒体をハニカム構造の担体に触媒を担持した構成とし、上記導入されるガス中の水素濃度が急激に低下した部位における、単位面積当たりの触媒担持量を、他の部位よりも多くすることで、単位面積当たりの水素反応量を増加させる。このようにすると、水素濃度を所定のレベルまで低下させるのに必要な触媒体のガス流れ方向の長さを短くし、小型化できる。つまり、排出ガス中の大半の水素が一気に反応した後は、排出ガス中の水素濃度が低くなって、ガスと触媒表面の濃度勾配が小さくなる上、ガスが水素の発熱により体積膨張することによって流速が増大する。すると、水素が徐々にしか反応しないために、水素量が少量であるにもかかわらず、処理に相当の距離を要することになるが、上記構成とすることで、これを回避し、小型化で処理能力を大きい装置が得られる。

【0024】あるいは、請求項10のように、上記触媒体をハニカム構造の担体に触媒を担持した構成とするとともに、導入されるガス中の水素濃度が急激に低下した部位における、単位体積当たりの触媒の担持面積が、他の部位よりも大きくなるようにしてもよい。このようにしても同様の効果が得られ、水素濃度勾配とガス流速による反応の低下を防止して、小型で処理能力が大きい装置を実現できる。

【0025】請求項11のように、上記触媒体は、例え

ば、セラミック製または金属製のハニカム構造の担体を用いて構成することができる。セラミックハニカム担体は、型を用いた大量生産が可能で、コスト低減が可能である。また、金属ハニカム担体は、金属の波板と平板を重ね合わせて作成され、ギヤ歯車により波板を容易に加工できる上、同じ波板を利用しても、山高さ等の変更が容易なため、製作しやすく、安価である。また、セラミック製では、熱膨張で割れが生じないように外周を支持するセラミックシートを巻く必要があって、長手方向に短い担体は作製しにくい。このような場合には、金属製とすると有利である。

【0026】上記課題を解決するために、請求項12の装置では、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を設けるとともに、上記触媒体をガス流れの方向に複数に分割して、それぞれ異なる材質とする。この時、上流側にセラミック製の担体を用いた触媒体を配置し、その下流側に金属製の担体を用いた触媒体を配置すると、上記触媒体に導入されるガス中の水分をセラミック担体に吸着させるとともに、金属担体部で発生した熱の伝導および輻射で乾燥させることができる。

【0027】発電中に燃料電池の空気極から排出されるガスには、通常、多量の水蒸気が含まれるため、触媒表面に水分が吸収されて、反応が進まず、水素の排出直後のエミッションが悪化するおそれがある。そこで、上記構成のように、上流側にセラミック担体を用いて水分を吸収させることで、下流側への水分の流入が抑えられ、ドライガスとなるため、速やかに反応が開始される。また、下流側を金属担体としたので、急激に発生した熱を熱伝導の良い担体全域に分散して、金属担体部の入口付近で局所的な過昇温が生じるのを防止できる。金属担体部で反応が開始されれば、水分を吸収したセラミック担体部は、金属担体部からの熱で乾燥されるので、次の水素排出までに空気極から排出される水分を十分吸収可能である。

【0028】請求項13のように、上記触媒体の設置位置は、上記空気極からの排出ガスを大気への放出するための排出通路内とするとよい。上記水素極からの水素の排出は連続的でなく、通常、ある時間間隔において（例えば、10分に一度）排出される。一方、上記空気極からは、常時、ガスが排出されているので、この排出ガスに上記触媒体を常に接触させることにより、水素が排出されない間を利用して、上記触媒体を冷却することができる。よって、上記触媒体の過度の昇温を避けるために排出水素量を抑制する等の必要がなく、時間当りに燃焼させる水素量の増大が可能である。また、従来より、燃料電池に常設される排出通路に上記触媒体を設置することで、装置構成を簡単にし、省スペース化が図れる。

【0029】好適には、請求項14のように、上記触媒体の設置位置を、上記排出通路内で、かつ大気への放出

口の近傍とするとよい。これにより、導入されるガスの単位体積当たりの水分量を低下させることができる。つまり、燃料電池では、発電効率を上げるために、内部を加圧状態とし、ほぼ飽和水蒸気となったガスを導入して燃焼させるので、多量の水蒸気を含むガスが排出される。排出通路では出口に近いほど、ガスの圧力が低くなり、気体として保持できる水分量が多いことから、ドライに近い状態で上記触媒体に導入することができ、触媒表面上で水分が凝結しにくくなる。よって、触媒と水蒸気の衝突機会を低減させて、触媒の燃焼開始までの時間を短縮できる。

【0030】請求項15のように、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備える装置にて水素の処理を行うために、具体的には、上記水素極側から排出される水素を含む排出ガスを上記触媒体に導くための水素排出通路と、上記水素排出通路を開閉する開閉手段と、上記開閉手段の開閉を制御し、上記水素排出通路を定期的に開放して上記水素を含む排出ガスを上記触媒体に導入する制御手段を設ける。該制御手段は、上記触媒体の予熱期間中、上記開閉手段の開閉を短時間に繰り返して間欠的に上記水素を含む排出ガスを導入する制御を行う。

【0031】上記水素排出通路を定期的に開放して上記水素を含む排出ガスを上記触媒体に導入する場合、触媒を活性化するには、まず、例えば、少量の水素を導入して活性化させ、その後規定量の水素を排出する制御が容易に考えられるが、これでは、水蒸気にさらされて活性が低下している触媒に十分な反応を生起することができず、エミッションは悪化する。これに対し、ある一定量の水素を、ごく短時間に排出した場合は、触媒燃焼が一部起きるため、投入された一部の水素は浄化される。これを複数回繰り返した後に、所定量の水素を排出すれば、触媒を初期から高い活性で使用でき、エミッションを低く抑えることが防止できる。

【0032】請求項16の装置は、燃料電池の水素極側から排出される水素を含む排出ガスを処理するための装置であって、上記水素を含む排出ガスを、上記空気極側から排出される酸素を含む排出ガスを支燃ガスとして触媒燃焼させる触媒体を備えている。この装置では、上記触媒体に、上記水素を含む排出ガスを導入するための通路を設けるとともに、該通路を、上記触媒体の各部位が所望の発熱量となるように、上記触媒体のガス流れ方向の複数箇所に上記水素を含む排出ガスを分割して導入する構造としたことを特徴とする。

【0033】上記構成では、上記触媒体の構造を変更する代わりに、上記触媒体に上記水素を含む排出ガスを導入するための通路の構造を、上記触媒体の各部位が所望の発熱量となるように変更する。上記触媒体の各部位の発熱量は、導入される水素量で調整できるので、上記水素を含む排出ガスを各部位に分割供給して、それぞれの

供給量を調整すれば、局所的な温度上昇を防止し、簡素な構成で安全に効率よく水素を処理することができる。

【0034】請求項17の装置は、上記触媒体に、上記水素を含む排出ガスを導入するための通路を設けるとともに、該通路に、上記触媒体のガス流れ方向の複数箇所に上記水素を含む排出ガスを分割して導入する複数の分岐路を設ける。そして、これら複数の分岐路を、対応する上記触媒体の各部位が所望の発熱量となるように構成する。

【0035】具体的には、上記複数の分岐路から、上記水素を含む排出ガスを上記触媒体の各部位に導入すれば、各分岐路の形状等を変更することで、上記触媒体の各部位に導入するガス流量を調整することができる。よって、上記触媒体の各部位を所望の発熱量とし、局所的な温度上昇等を防止して、安全に効率よい水素処理装置とすることができる。

【0036】請求項18の装置は、上記触媒体に、上記水素を含む排出ガスを導入するための通路を設け、該通路に、上記触媒体のガス流れ方向の複数箇所に上記水素を含む排出ガスを分割して導入する複数の分岐路を設ける。さらに、これら複数の分岐路を、上記触媒体のガス流れ方向の上流側に下流側よりも多くの上記水素を含む排出ガスが導入される構造とする。

【0037】通常の発電時には、水蒸気を多く含んだガスが排出されるため、触媒表面が濡れて反応が起こりにくくなるが、上記触媒体の上流側により多くの上記水素を含む排出ガスが導入される通路構成とすることで、上流の触媒体において集中的に発熱させ、速やかに触媒を活性化することができる。また、発電停止時や起動時は、水素濃度が高く水蒸気量が少ないガスとなるが、上記複数の分岐路により下流側の触媒体にもガスが導入されるので、触媒全体で発熱させ、安全かつ効率のよい処理を行うことが可能になる。

【0038】請求項19のように、具体的には、上記複数の分岐路の流路断面積を変更する。例えば、上記触媒体の上流側に対応する分岐路の流路断面積を大きくし、通気抵抗を小さくして、上記触媒体のガス流れ方向の上流側に下流側よりも多くの上記水素を含む排出ガスが導入されるようにすることができる。

【0039】あるいは、請求項20のように、上記複数の分岐路の端部に設けられ、上記触媒体の各部位に上記水素を含む排出ガスを導入するための導入口の開口面積または数を変更することもできる。例えば、上記導入口の開口面積を大きく、または数を多くすれば、導入されるガス量が多くなるので、上記触媒体のガス流れ方向の上流側に下流側よりも多くの上記水素を含む排出ガスが導入されるようにすることができる。

【0040】上記項21の構成では、上記複数の分岐路への上記水素を含む排出ガスの流入を制御する流路切替手段を設ける。そして、燃料電池の発電時には、上記触

媒体のガス流れ方向の上流側に、上記水素を含む排出ガスのほぼ全量が導入されるように、流路切替を行い、発電停止時または起動時には、上記触媒体のガス流れ方向の下流側にも、上記水素を含む排出ガスが導入されるように、流路切替を行うことを特徴としている。

【0041】発電時には、水蒸気を多く含んだガスが排出され、乾燥したガスより触媒体の温度が上昇しにくい。例えば、上記触媒体の上流側にガスを導入する分岐路のみを開いて、上記水素を含む排出ガスのほぼ全量を上流部に供給して、速やかに温度を上昇させることができる。一方、発電停止時や起動時は、水素濃度が高く水蒸気量が少ないため、上記触媒体の下流側にガスを導入する分岐路も開いて、触媒全体で発熱させれば、より安全に効率よく処理を行うことができる。

【0042】上記項22の構成では、上記触媒体の、ガス流れ方向の前面に、発泡金属よりなる気液分離部材を設ける。発泡金属は比表面積が非常に大きいので、その表面で排出ガス中の水分を積極的に凝縮させて、除去することができる。このようにすると、排出ガス中の水分が上記触媒体内で凝縮して触媒表面を濡らすことがないので、触媒反応を促進して効率よい処理が可能になる。

【0043】上記項23の構成では、上記気液分離部材のガス流れ方向の前面に、凝縮水が存在しやすい部位を覆う遮蔽部材を設ける。凝縮水で触媒が濡れた部位に水素を含むガスが流入すると、すり抜けが生じるので、凝縮水がたまりやすい部位を覆うように気液分離部材を設けることで、すり抜けを防止し、確実に水素を処理することができる。

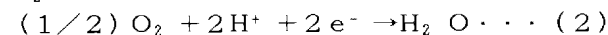
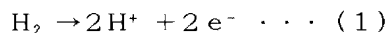
【0044】

【発明の実施の形態】以下、図面により本発明の第1の実施の形態を説明する。図1は、自動車用の燃料電池システムの概略構成を示す図で、燃料電池1には、エアポンプ等の空気供給手段31と、高圧圧縮水素タンク等の水素貯蔵手段32が接続され、排出通路4には、触媒体22を備えた排出水素処理装置2が設置されている。燃料電池1は、固体高分子電解質膜12と、その一方の表面に設けた空気極（陽極）13と、他方の表面に設けた水素極（陰極）14からなる単位セル11を主要部として有し、この単位セル11を、電極に接する表面にガス流路となる溝を形成したセパレータ（図略）を介して、多数積層することにより構成される。排出水素処理装置2の上流側には、消音器5が設置されている。

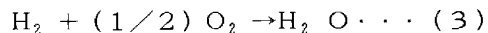
【0045】固体高分子電解質膜12には、例えば、フッ素樹脂系のプロトン導電性固体高分子電解質膜が用いられる。空気極13および水素極14には、導電性とガス透過性を兼ね備えた材料、例えば、カーボクロスやカーボンペーパー等が用いられ、電極反応を促進するための触媒を担持させることもできる。空気極13で使用される酸素は、空気供給手段31から加圧空気として供給され、また、水素極14で使用される水素は、水素貯蔵



手段32から、同じく加圧ガスの状態で燃料電池1に供給される。この時、水素極14では、下記式(1)に示す電極反応により水素イオンが生成する際に電子を放出し、その電子が空気極13側へ移動することによって発電する。水素イオンは高分子電解質膜12内を通過して、空気極13に達し、下記式(2)に示す電極反応により水が生成する。



なお、電池全体の反応は、式(3)のようになる。



【0046】ここで、上記式(1)のように、水素は水素極14でイオンに分解され、固体高分子電解質膜12内を空気極13側へ拡散していく。従って、水素極14からの排出ガスは、理論上は、電極反応で使用されなかった余剰の水素ガスのみとなり、これをポンプ等の水素循環手段33を用いて、水素貯蔵手段32からの水素供給経路へ循環させ、水素極14で使用された分の水素が新たに供給させるシステムとすれば、発電を継続することができるはずである。ところが、実際には、固体高分子電解質膜12を通過して空気極13側の窒素や生成水が水素極14側に流入するために、水素循環手段33を用いて水素を循環させる運転を続けると、水素極14側の水素濃度が先の不純物によって低下する。そこで、水素濃度を一定以上に保つため、定期的に水素極14側のガスを排出して水素を導入する水素置換を行う。

【0047】具体的には、水素循環手段33と排出通路4とを接続する水素排出通路41を設けて、該水素排出通路41に電磁バルブ等の開閉手段34を設置する。開閉手段による水素排出通路41の開閉は、制御手段35を用いて制御することができ、例えば10分に一度、数秒間、水素排出通路41を開放して、水素を含む排出ガスを排出通路4へ排出する。この定期的な水素排出時の制御の詳細は後述する。排出通路4は、空気極13側から排出される酸素を含む排出ガスを大気へ放出するための通路であり、本発明では、この酸素を含む排出ガスを支燃ガスとして、排出水素処理装置2に導入し、水素を含む排出ガスを触媒燃焼させて水素濃度を十分低減させた後、排出する。また、空気極13側から排出される酸素を含む排出ガスは、運転中、常に排出されるので、水素の排出による発熱で高温となった排出水素処理装置2内の触媒体22は、次の水素排出までにガス温度まで冷却される。

【0048】なお、図のように、消音器5を設ける場合には、排出水素処理装置2を、消音器5の下流側に配置することが望ましい。これは、排出通路4内が下流側ほど、つまり大気への放出口に近いほど低圧力となり、ガスの単位体積当たりの水分量が少なくなるためである。バーナー等、一般的な燃焼器は、騒音低減等の観点から消音器5の上流側に配置されることが多いが、本発明で

は、比較的低温で触媒燃焼させるため、凝縮水の発生による温度低下等を回避する目的で、上記位置に設置する。また、消音器5を上流側に設置することにより、水素を含む排出ガスと酸素を含む排出ガスが、消音器5内で良好にミキシングされて排出水素処理装置2を導入され、燃焼効率を向上させる利点もある。

【0049】排出水素処理装置2は、筒状容器21内に、水素を触媒燃焼させるための触媒体22を配設してなる。図2に詳細を示すように、触媒体22は、ガス流れの上流側に位置する上流側触媒体201と、下流側に位置する下流側触媒体202とに区画されており、これら触媒体201、202は、いずれも、ガスの流れ方向と平行な多数の通路を有するハニカム構造の担体に、触媒を担持して形成されている。ここで、本実施の形態では、上流側触媒体201の通路壁211が、下流側触媒体202の通路壁212より厚くなるように形成する。上流側触媒体201の通路と下流側触媒体202の通路の断面積、単位面積当たりの触媒担持量は同じとする。

【0050】この時、壁厚を厚くした上流側触媒体201は、単位面積当たりの熱容量が、下流側触媒体202よりも大きくなる。一方、壁厚が厚いと各通路の表面積は小さくなるので、単位体積当たりの発熱面積、すなわち、触媒の担持面積は上流側触媒体201の方が、下流側触媒体202よりも小さくなる。触媒体22に導入される排出ガス中の水素濃度は、入口に近い上流側端部で最も高く、従って、発熱量も多くなりやすいが、本実施の形態では、この部分の熱容量を大きくして、熱を吸収しやすくしたので、過度の昇温が防止される。また、触媒の担持面積(担持量)を小さくしたので、発生する熱自体が小さくなる。

【0051】上流側触媒体201および下流側触媒体202の長手方向長は、次のようにして設定する。触媒体22内の水素濃度分布は、一般に、入口部で最も高く、急速に反応が進んで急減した後、緩やかに低下を続ける。つまり、触媒体の壁厚が一定である場合(上流側触媒体201の壁厚を厚くしていない場合)、図3に点線で示すように、触媒体22の上流側(図にxで示す領域)で水素が触媒と接触して急速に反応が進み、触媒体22温度も急上昇するが、次いで、水素濃度の減少とともに触媒体22温度も急減する。触媒体22の下流側(図にyで示す領域)では、水素濃度と同様、緩やかに温度が低下して、距離yではほぼ目標温度となる。そこで、図2のように、これらx、yに対応させて、上流側触媒体201と下流側触媒体202の長手方向の長さx、yを設定する。こうすることで、濃度の高いガスが供給され続け、触媒体温度が比較的高い領域xの温度を低く抑えることが可能となる。

【0052】上記構造の触媒体22を製作する場合には、まず、例えば、ジルコニア等のセラミックを通常の方法で型成形・焼成して所定形状の担体を作製し、触媒



溶液に浸漬することにより、上流側触媒体201と下流側触媒体202とを、それぞれ別体に製作した後、密着させて一体化すればよい。なお、ジルコニア等のセラミック担体は、成形が簡単で量産しやすい利点があるが、担体の材質は、これに限らず、例えば、金属製の担体を用いることもできる。金属担体は、水分を含みにくく、熱伝導がよいので濃度分布が少なくできる。

【0053】本実施の形態の作動を次に説明する。図1の燃料電池1に、空気供給手段31から空気を、水素貯蔵手段32から水素を供給すると、上記式(1)、

(2)のように反応し、発電する。水素貯蔵手段32から供給される水素は、循環手段33によって循環され、水素貯蔵手段32からは実質発電で消費された水素量だけが供給される。ただし、循環される間に、空気極13から窒素や水蒸気が混入し水素濃度が低下して一定濃度以下となると発電に使用できなくなるため、開閉手段34を開いて、水素排出通路41から排出通路4に排出し、排出水素処理装置2内で触媒燃焼させてクリーンなガスとする。

【0054】触媒体22に導入された水素は、空気極13から排出される酸素を含むガスを支燃ガスとして燃焼する。ここで、上述したように、触媒体22内の水素濃度分布は、一般に、入口部で最も高く、急速に反応が進んで温度上昇するが、触媒体22は、上流側触媒体201の壁厚を下流側触媒体202より厚くしており、熱容量が大きいために、熱を吸収しやすい。また、触媒担持面積が小さいので、発熱量自体を抑制できる。

【0055】触媒体の熱容量は、定常運転時にはあまり影響するものではないが、本装置のように水素を含むガスが間欠的に供給され、短時間に大きな発熱を伴う場合には、触媒体22の上流側触媒体201を熱吸収体として使用することで、過度の発熱を抑制することができる。その効果は図3に明らかで、壁厚が一定である場合に比べて、壁厚が厚い上流側触媒体201が熱を吸収するとともに、発熱面積が小さくなることによって、触媒体温度の上昇が小さくなり、最高温度が大きく低下している。上流側触媒体201で反応しなかった水素が燃焼するために、下流側触媒体202内に入ると触媒体温度が再び上昇し、その後、低下してほぼ一定温度となる。

【0056】このように、上記構成によれば、過度の温度上昇を抑制しつつ触媒体22全体で効果的に触媒燃焼することができ、安全かつ効率よく排出水素を処理することができる。また、排出水素処理装置2を、空気極13の排出通路4に設置したので、支燃ガス供給のための新たな装置を設ける必要がなく、構成を簡略化し、コストを低減できる。

【0057】図4に本発明の第2の実施の形態における触媒体22構成を示す。上記第1の実施の形態では、上流側触媒体201が過昇温となりやすい点に着目して、その温度上昇を抑制する構成を示したが、本実施の形態

では、図4(a)のように、下流側触媒体202の単位面積当たりの触媒担持量を、上流側触媒体201よりも多くして、下流側触媒体202の燃焼効率を高め、触媒体22の小型化を図っている。上流側触媒体201と下流側触媒体202は、同一構造の担体を用いて一体に形成されており、通路断面積、壁厚は同じである。

【0058】同一の担体を用いて上流側触媒体201と下流側触媒体202とで触媒担持量を変えるには、触媒濃度の異なる2種類の触媒溶液を用意し、担体の一方の端面から長さ $x$ の部分を低濃度の触媒溶液に浸漬して、上流側触媒体201とするとともに、残る長さ $y$ の部分を他方の端面側から高濃度の触媒溶液に浸漬して、下流側触媒体202とすればよい。

【0059】一般に、触媒体22内の水素濃度は、図5(b)に示すように、入口部で最も高く、急速に反応が進んで距離 $x$ までに急減し、その後は緩やかに低下を続けて距離 $y$ でほぼ所定の低濃度となる。つまり、上流側触媒体201と下流側触媒体202の単位面積当たりの触媒担持量が同じ場合、水素濃度を所定濃度以下とするには、下流側触媒体202の長手方向長さを距離 $y$ に対応する長さとする必要があり、体格が大きくなる(図5(a))。

【0060】これに対し、本実施の形態では、下流側触媒体202の触媒担持量が多く、反応性が高まって温度も上昇しやすいので、触媒燃焼量が増加する。よって、図4(b)のように、距離 $y$ よりも短い距離 $y'$ で、水素濃度を十分低くすることができ、下流側触媒体202の長さをその分短くできるので、触媒体22をコンパクトにし、小型で処理能力の高い装置とすることができる。また、下流側触媒体202の処理能力を高めたことで、水素の流れ始め、つまり触媒温度が低くて活性が低い時でも、水素の反応が進み、エミッションの悪化を防止することができる。しかも、下流側触媒体202は、定常時の水素濃度分布が低いので、処理能力を高くしても、必要以上に反応熱が発生して過昇温となることがない。逆に、立ち上がり時には、この部位で反応が進みだせば、その輻射および伝熱にて上流側の触媒入口部が活性化するので、部分的な過昇温を抑制しつつ触媒体全体を活性化して効率よく処理することができる。

【0061】図6に本発明の第3の実施の形態における触媒体22構成を示す。本実施の形態では、上流側触媒体201と下流側触媒体202を構造の異なる担体を用いて構成し、図6(a)のように、下流側触媒体202の担体を、通路断面積が上流側触媒体201よりも小さく、壁厚も薄く形成した担体とする。単位面積当たりの触媒担持量は、上流側触媒体201と下流側触媒体202とで同じとする。

【0062】上記構成によれば、壁厚が薄い下流側触媒体202は、熱容量が小さいので、触媒体温度が高くなりやすく、反応定数が大きくなるので処理量が増大す

る。また、通路断面積が小さく、単位体積当たりの発熱面積（触媒担持面積）が大きくなることも触媒燃焼量の増加に寄与する。よって、上記第2の実施の形態と同様、下流側触媒202の長手方向の長さを $y'$ と短くすることができ、また、立ち上がり時には、下流側触媒202で水素の反応が進み、エミッションの悪化を防止するとともに、上流側触媒201の活性化を促進する効果が得られる。

【0063】図7に本発明の第4の実施の形態における触媒22構成を示す。本実施の形態では、上流側触媒201と下流側触媒202を構造の異なる担体を用いて構成し、図7(a)のように、上流側触媒201にジルコニア等のセラミック担体を用い、下流側触媒202には金属担体を用いる。下流側触媒202を構成するは金属担体は、金属箔よりなる平板23と波板24を図7(b)のように重ねて積層しても、重ねたものを巻き回してハニカム状としてもよい。金属担体を用いる下流側触媒202は、上流側触媒201よりも壁厚が薄く、また、通路断面積が小さくなるように形成してある。

【0064】金属担体は、セラミック担体よりも、単位体積当たりの熱容量を小さくできるため、これを下流側触媒202に用いれば、運転初期の触媒22が湿った状態でも、早期に活性化できる上、定常燃焼時には、水素濃度の薄いガスとのみ接触するので、過昇温のおそれがない。一方、燃料電池の空気極から排出されるガスには、通常、多量の水蒸気が含まれるため、触媒表面に水分が吸収されて、反応が阻害されるおそれがあるが、セラミック担体は、担体自身が水分を吸収するため、これを上流側触媒201に用いると、ガスのドライ化に大きく貢献する。また、吸収された水分は、下流側の金属担体で発生する熱の伝導および輻射で乾燥される。

【0065】さらに、金属担体は、金属箔の厚みや波板のピッチ、山の高さを変更することで、形状の変更が容易にできるので、本発明のように、上流側触媒201と下流側触媒202で担体の熱容量や触媒担持面積を変更する場合に、製作が容易になる。また、セラミック担体では保持が難しくなる長手方向に短い形状も、容易に製作、設置することができる。

【0066】図8は、水素極14からの排出ガスを、水素排出通路41から排出通路4に排出する際の、制御手段35による開閉手段34の開閉制御の一例である。水素極14の水素濃度を一定以上に保持するには、図示するように、定期的に（例えば10分に一度）、電磁バルブ等の開閉手段34を開いて、水素を含む排出ガスを排出する必要がある。この時、図中、破線で示すように、所定のガス量の全量を一度に排出する方法が一般的であるが、この方法では、触媒22が活性化していない排出水素処理装置2内に、水素濃度の比較的高いガスが流入するために、始動初期の排出水素濃度が一時的に目標

値を越えてしまう。また、活性化後は触媒燃焼量が増大して触媒22が高温となりやすい。

【0067】このため、図中、実線で示すように、制御手段35により、開閉手段34の開閉を短時間に繰り返す制御を行って、触媒22の予熱期間中、触媒が活性化する程度の水素を間欠的に排出水素処理装置2内に導入する。このように、ある程度高濃度の水素ガスを、ごく短時間に導入することで、水蒸気で湿った触媒表面を乾燥させて、瞬時に活性化し、始動初期の排出水素を目標値より低く抑えると同時に、効果的に触媒を活性化できる。これを適当な回数繰り返した後に、残りの水素を排出すれば、効率よく触媒燃焼を行うことができ、排気エミッションの優れた装置が実現する。

【0068】このように、本発明によれば、空気極13からの排出ガスを利用した簡易かつ高性能な排出水素処理装置が実現できる。また、触媒22は、過昇温が起きやすい部位には、熱容量の比較的高い担体を用いたり、触媒担持量や発熱面積を変化させることで、容易に過昇温を解消し、あるいは、通常、水素濃度・触媒温度が低く、水素処理効率の低い部位には、触媒担持量や発熱面積を増加することで、処理能力を高めた構成として、触媒22の小型化を可能にしている。さらに、制御方法を最適化することで、立ち上がり時のエミッションの悪化や、過昇温を防止することができる。

【0069】なお、上記各実施の形態で示した上流側触媒201および下流側触媒202の構成や制御方法は、それぞれ単独で用いても、目的に応じていくつかを組み合わせてもよく、さらに良好な排出水素処理を行うことができる。

【0070】また、上記各実施の形態では、排出水素処理装置2上流の排出通路4に、水素循環手段33からの水素排出通路41を接続して、水素を含む排出ガスを触媒22の前面に導入したが、水素排出通路41を分岐し、触媒22の複数の部位に水素を含む排出ガスを導入するようにしてもよく、運転状態に応じたより適切な処理が可能となる。その一例を次に示す。

【0071】図9は、本発明の第5の実施の形態における燃料電池システムの概略構成である。図示するように、本実施の形態では、上記図1に示した燃料電池システムにおいて、水素貯蔵手段32から燃料電池1へ至る通路の途中にバルブ36を、水素極14から水素循環手段33へ至る通路の途中にバルブ37をそれぞれ設けている。これにより、発電を停止した時に、バルブ36、37を閉じて燃料電池1内に水素を閉じ込め、水素極14側からの水素の漏れや消費を回避することが可能となる。ただし、発電中の燃料電池1内は加圧状態となっており、これに対して空気極13側は停止後まもなく大気圧になるため、圧力差により水素極14側から空気極13側へ水素が移動して両極ともに高濃度の水素を含む混合ガスが充満することになる。この場合、燃料電池1を

再起動する時に、水素極14側には水素を、空気極13側には空気を流して混合ガスをバージする必要がある。

【0072】そこで、本実施の形態では、制御手段35により、発電停止時にバルブ36を閉じた後、水素極14が大気圧になるまでバルブ37を開放し、開閉手段34を開いて水素極14側のガスを水素排出通路41に排出する。これにより、両極間の圧力差を解消し、ガスを混合を最小限に抑えることができる。水素極14が大気圧になったらバルブ37、開閉手段34は閉じる。

【0073】この発電停止時に排出されるガスは、発電中に排出されるガスよりも水素濃度が高く、また支燃ガスとなる空気極13側の排出ガスもアイドリング相当と少な上、電極反応で生成する水分を含まないため乾燥している。このため、全量を触媒体22の前面に導入すると、触媒反応が急激に立ち上がって、過昇温を起こしやすい。これを回避するため、本実施の形態では、触媒体22をガス流れ方向に3分割して配置する一方、水素排出通路41を分岐して、各分岐路41A、41B、41Cから、分割された触媒体22A、22B、22Cの前面にそれぞれ水素を含む排出ガスが導入される構成とする。この時、最上流の触媒体22Aに、他の触媒体22B、22Cより多くのガスが供給されるようにし、前段の触媒による燃焼ガスが流れるために温度が高くなる後段側において、ガス導入量がより少なくなるようにするとよい。

【0074】例えば、図10に示す構成では、最上流の分岐路41Aを構成する管の管径が最も大きく、下流の分岐路41B、41Cの管径が順次、小さくなるようにする。各分岐路41A、41B、41Cの端部に開口して触媒体22A、22B、22Cにガスを導入する導入口42A、42B、42Cの径は、ここでは同径とし、数はいずれも1つとしている。管径の異なる管で分岐路を構成すると、管内圧損に応じた流量が導入口から吹き出すので、上流側ほど多くのガスが供給されるようにすることができる。

【0075】上記構成によれば、発電停止時に水素濃度の高い乾燥したガスが、比較的短時間に多量に排出されても、水素排出通路41の分岐路41A、41B、41Cから、分割された触媒体22A、22B、22Cのそれぞれに水素を含むガスが導入されるので、最上流の触媒体22Aが局所的に過熱するのを防止できる。また、図10のように上流から下流へ向けて分岐路41A、41B、41Cの管径を小さくして、上流側でガス導入量が多くなり下流側ほど少なくなるようにしたので、高温の燃焼ガスが流れることにより下流側の触媒体22B、22Cが過熱することもない。図11は、排出水素処理装置2の長手方向距離と燃焼ガス温度の関係を示すもので、触媒体22全体で発熱させて、過昇温を防ぎつつ触媒燃焼させることができる。なお、起動時も、発電開始

直後は、水分を含まないガスが排出されるが、同様にして過昇温を抑制することができる。

【0076】また、通常発電時には、水蒸気を多く含んだガスが排出されるため、乾燥したガスより触媒反応が起こりにくくなるが、触媒体22を、最上流の触媒体22Aに他の触媒体22B、22Cよりも多くの水素が供給されるように構成したので、最上流の触媒体22Aで集中的に発熱し、速やかに温度が上昇して優れた浄化性能を発揮する。このように、本実施の形態によれば、発電中および発電停止時のいずれにも好適に用いられ、状態の異なる排出ガス中の水素を、安全にしかも効果的に触媒反応させることができ、エミッションを低く抑えることができる。

【0077】図12、図13は、分岐路41A、41B、41Cの構成の他の例である。例えば、図12のように、分岐路41A、41B、41Cの管径をいずれも同じにした場合には、触媒体22A、22B、22Cに水素を含むガスを導入する導入口43A、43B、43Cの径または数を変更することにより、流量を調整してもよい。ここでは最上流の触媒体22Aの導入口43Aの径を、他の導入口43B、43Cより大きくする。また、最下流の触媒体22Cの導入口43Cの数を、他の導入口43B、43Cより少なくしている。このようにしても、上流から下流に向けて水素を含むガスの吹き出し量が少なくなる。

【0078】あるいは、図13のように、分岐路41A、41B、41Cの管径、導入口44A、44B、44Cの径および数は同じとし、分岐路41Aと分岐路41Bの間の水素排出通路41にバルブ6を設けて、運転状態に応じてバルブ6を開閉する構成としてもよい。すなわち、通常発電時のように、水蒸気を含む反応しにくいガスを処理する際には、制御手段35によりバルブ6を閉じ、最上流の触媒体22Aに分岐路41Aの導入口44Aから水素を含むガスの全量が吹き出すようにする。一方、発電停止直後は、水素濃度が高く水蒸気量が少ないガスとなるので、制御手段35によりバルブ6を開き、下流側の触媒体22B、22Cにも分岐路41B、41Cの導入口44B、44Cから水素を含むガスが導入されるようにする。また、この構成において、各触媒体22A、22B、22Cの温度を検出する手段を設け、その結果をフィードバックさせてバルブ6の開閉を制御すれば、より均一な温度に触媒体22を制御でき、安全で効率のよい処理を行うことが可能になる。

【0079】なお、上記の構成にして水分を含む60～70℃程度のガス中で、触媒体22Aにほぼ常温の水素ガスを供給することにより、局所的にガス温度を下げ、しかも、触媒体22Aの表面にて水分を凝縮させることができる。よって、下流の触媒体22B、22Cに供給されるガスをできるだけ乾燥させて、触媒が不活性となるのを防止する効果も期待できる。

【0080】図14(a)、(b)は、本発明の第6の実施の形態における排水素処理装置2構成を示すもので、触媒体22の前面に、発泡金属よりなる気液分離部材7を密接して配置する。気液分離部材7は、触媒体22と同径の円板状で、比表面積が非常に大きい発泡金属の表面で、導入されるガス中の水分を積極的に凝縮させる。凝縮水は重力により下方に落下、除去される。これにより、触媒体22が冷えている時に、凝縮水で触媒表面が濡れ、活性が低下するのを防止する。また、凝縮水で触媒が不活性となった部位に、水素を含むガスが流入するとすり抜けが生じるので、凝縮水がたまりやすい触媒体22下部を覆うように、気液分離部材7の前面に、略円弧状の遮蔽部材8を配設する。これら気液分離部材7と遮蔽部材8、触媒体22は互いに密接に配置されるので、反応が開始されて触媒体22の温度が上昇すると、水分は再び蒸発して排出される。

【0081】なお、発泡金属は、内部の気孔が互いに連通しており、ガス流れに平行な流れ以外にもガスが流通する。よって、触媒体22の、遮蔽板8でふさがれた部位にも、いくらかの水素を含むガスが流入し、触媒反応が生起するため、触媒体22を無駄にする割合が少なく、効率的に浄化作用を行うことが可能となる。

#### 【図面の簡単な説明】

【図1】本発明の第1の実施の形態の排水素処理装置を含む燃料電池システムの全体構成を示す概略図である。

【図2】第1の実施の形態における触媒体の拡大斜視図である。

【図3】触媒体の長手方向距離と触媒体温度の関係を示す図である。

【図4】第2の実施の形態を示し、(a)は触媒体の拡大斜視図、(b)は触媒体の長手方向距離と水素濃度の関係を示す図である。

【図5】単位面積当たりの触媒担持量を一定とした場合を示し、(a)は触媒体の拡大斜視図、(b)は触媒体の長手方向距離と水素濃度の関係を示す図である。

【図6】第3の実施の形態を示し、(a)は触媒体の拡大斜視図、(b)は触媒体の長手方向距離と水素濃度の関係を示す図である。

【図7】第4の実施の形態を示し、(a)は触媒体の拡大斜視図、(b)は担体構成を説明するための部分拡大図である。

大斜視図、(b)は担体構成を説明するための部分拡大図である。

【図8】制御手段による水素の排出方法を説明するためのタイムチャートである。

【図9】本発明の第5の実施の形態における燃料電池システムの全体構成を示す概略図である。

【図10】第5の実施の形態における触媒体と分岐路の概略構成を示す拡大斜視図である。

【図11】排水素処理装置の長手方向距離と燃焼ガス温度の関係を示す図である。

【図12】分岐路構成の他の例を示す拡大図である。

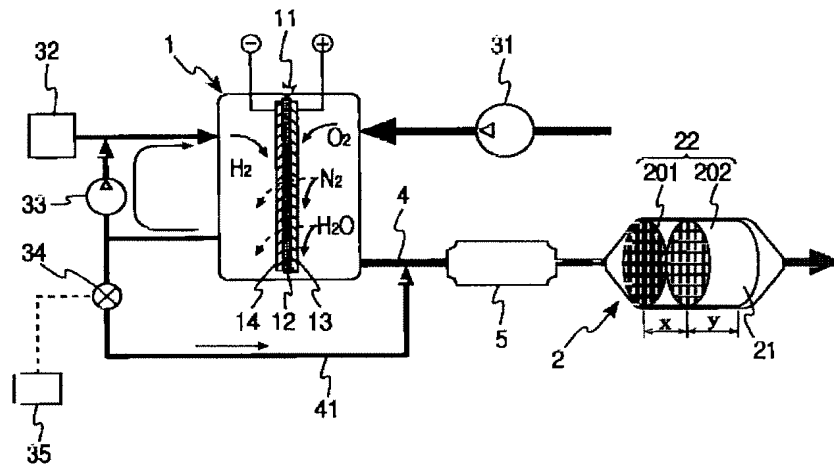
【図13】分岐路構成の他の例を示す拡大斜視図である。

【図14】第6の実施の形態における触媒体構成を示す拡大図で、(a)は正面図、(b)は断面図である。

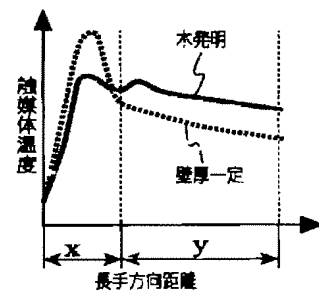
#### 【符号の説明】

- 1 燃料電池
- 11 単位セル
- 12 電解質膜
- 13 空気極
- 14 水素極
- 2 排水素処理装置
- 22 触媒体
- 201 上流側触媒体
- 202 下流側触媒体
- 22A、22B、22C 触媒体
- 31 空気供給手段
- 32 水素貯蔵手段
- 33 水素循環手段
- 34 開閉手段
- 35 制御手段
- 36 バルブ
- 37 バルブ
- 4 排出通路
- 41 水素排出通路
- 41A、41B、41C 分岐路
- 5 消音器
- 6 バルブ
- 7 気液分離部材
- 8 遮蔽部材

【図1】

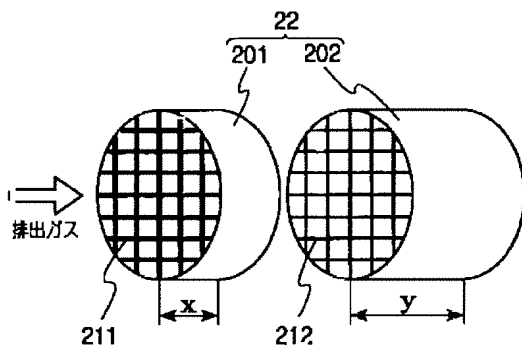


【図3】

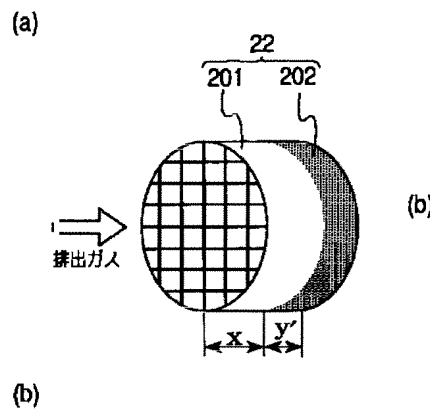


【図14】

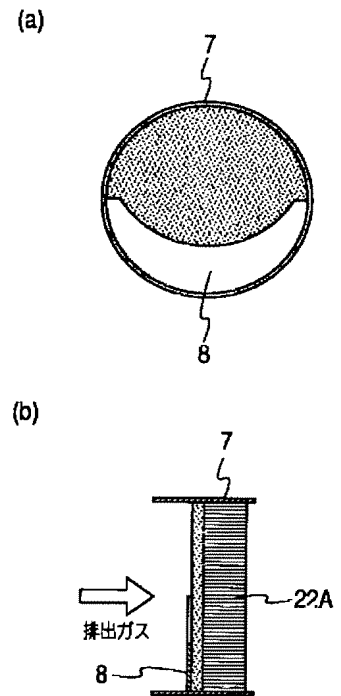
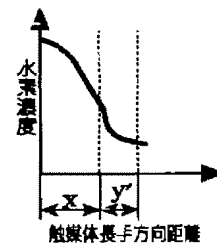
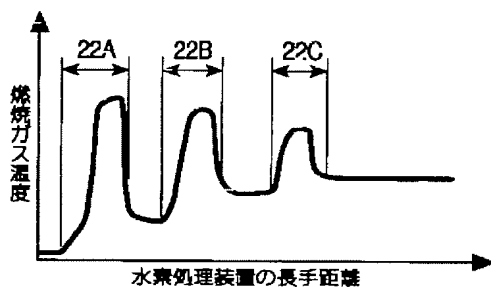
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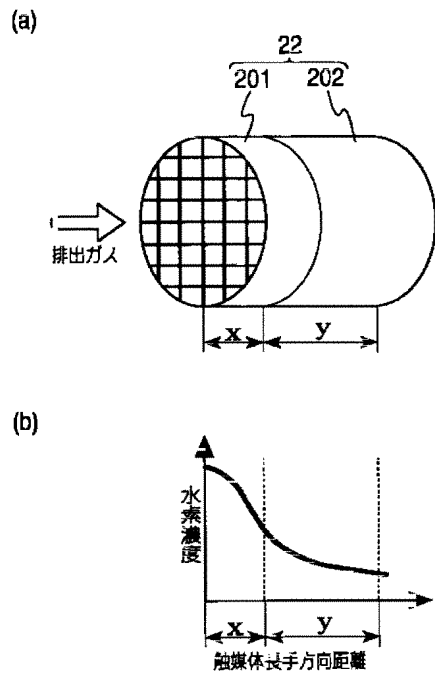
【図4】



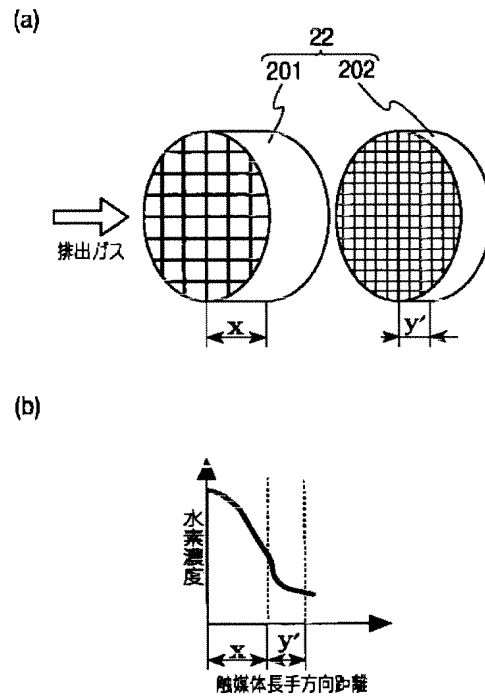
【図11】



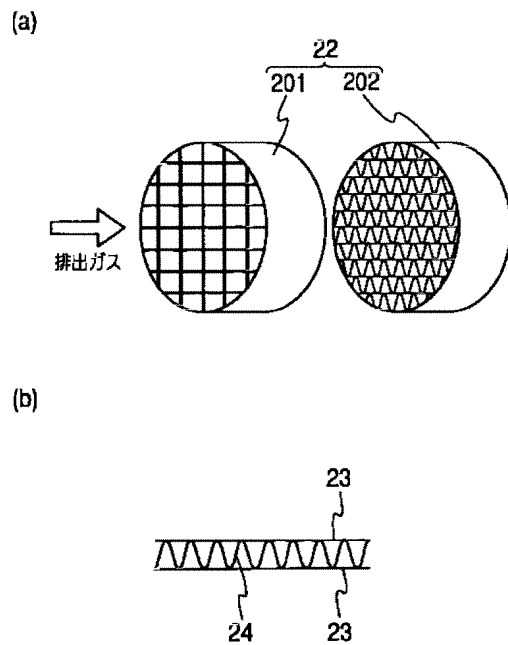
【図5】



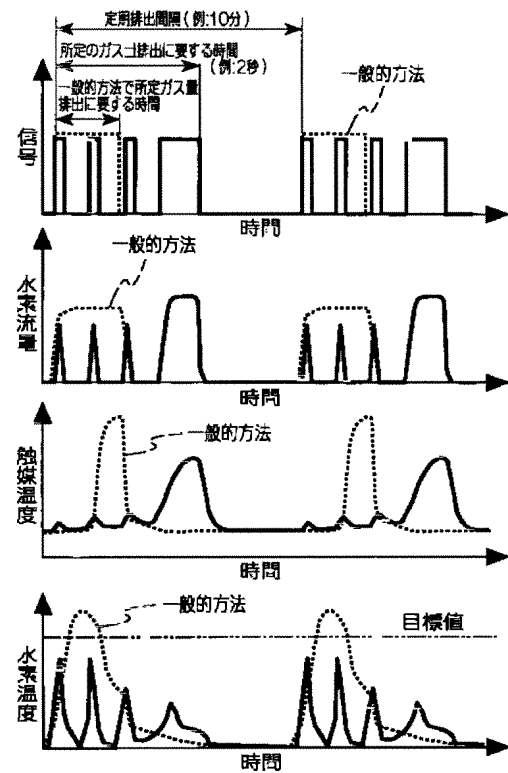
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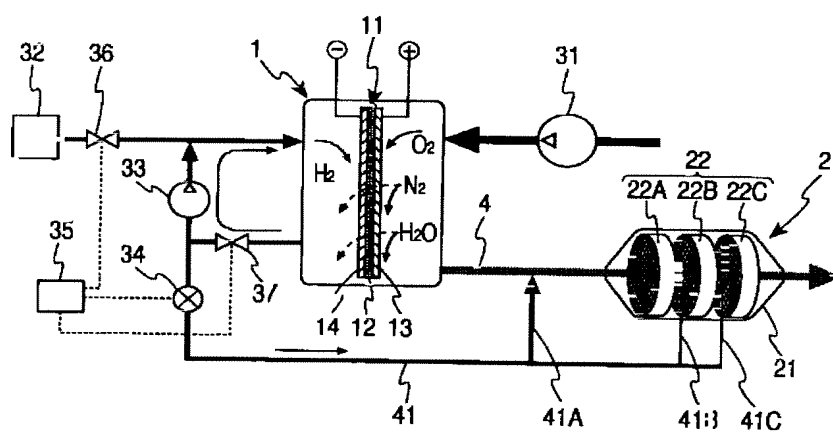
【図7】



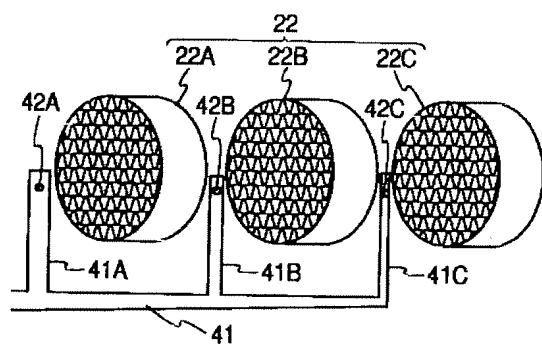
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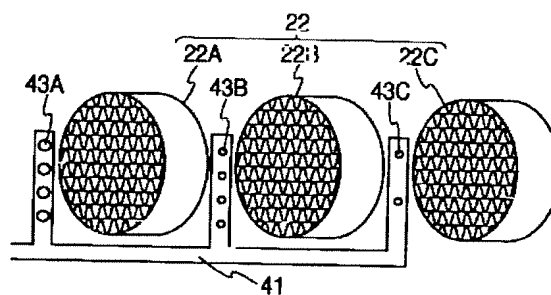
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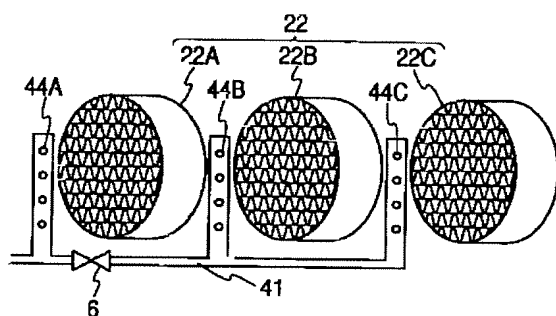
【図10】



【図12】



【図13】



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(51)Int. Cl.<sup>7</sup>

B 01 J 35/04

H 01 M 8/06

識別記号

3 0 1

F I

B 01 J 35/04

H 01 M 8/06

8/10

(参考)

3 0 1 B

W



F ターム(参考) 4D048 AA30 AB01 AC06 BB02 BB12  
BB15 BB16 CC21 CC32 CC38  
CC44  
4G069 AA01 CA04 CA07 CA11 DA06  
EA19 EA25  
5H026 AA06 EE02 EE11  
5H027 AA06 BA13 BA19

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## PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-142131

(43)Date of publication of application : 16.05.2003

(51)Int.Cl.

H01M 8/04

B01D 53/86

B01J 35/04

H01M 8/06

H01M 8/10

(21)Application number : 2002-015128

(71)Applicant : TOYOTA MOTOR CORP

(22)Date of filing :

24.01.2002

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(30)Priority

Priority number : 2001253247

Priority date : 23.08.2001

Priority country : JP

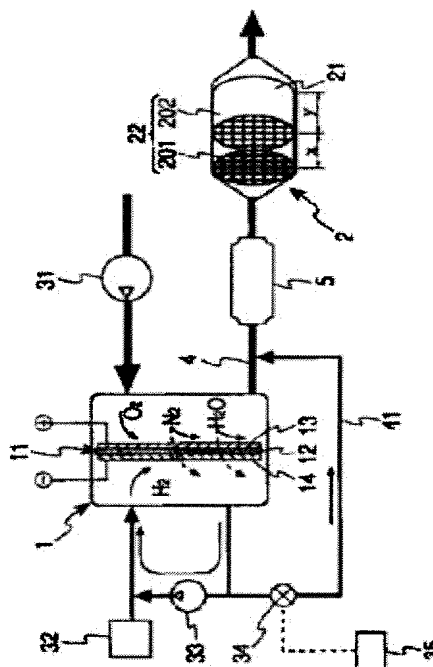
## (54) EXHAUSTED HYDROGEN TREATING DEVICE FOR FUEL CELL

(57)Abstract:

PROBLEM TO BE SOLVED: To provide an exhausted hydrogen treating device for a fuel cell capable of quickly and safely treating the hydrogen contained in the gas exhausted from the fuel cell.

SOLUTION: The fuel cell 1 is configured so that a hydrogen electrode 13 and air electrode 14 are installed with a solid highpolymer electrolyte film 12 interposed, wherein the exhaust gas containing hydrogen exhausted from the hydrogen electrode 13 is introduced to this exhausted hydrogen treating device 2 and subjected to a catalyst combustion with the aid of the exhaust gas containing oxygen exhausted from the air electrode 14 as a combustion assisting gas.

Overrise of the temperature of the catalyst 22 is suppressed because the thickness of the passage wall 211 of an upstream catalyst 20 with a higher hydrogen concentration in the gas is made greater than the passage wall 212 of an understream catalyst 202 so as to increase the heat capacity per unit volume, and it is possible to hold the whole catalyst 22 at a temperature allowing the catalyst to be combusted safely and efficiently.



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3.In the drawings, any words are not translated.

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**CLAIMS**

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[Claim(s)]

[Claim 1]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, An exhaust water matter processing unit of a fuel cell changing structure of the above-mentioned catalyst body according to hydrogen concentration distribution in gas which is provided with a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas, and to which catalyzed combustion is carried out, and is introduced.

[Claim 2]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, An exhaust water matter processing unit of a fuel cell constituting the above-mentioned catalyst body so that calorific capacity per unit volume of a part where hydrogen concentration in gas introduced is high may become higher than other parts.

[Claim 3]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, An exhaust water matter processing unit of a fuel cell constituting the above-mentioned catalyst body so that calorific value per unit volume of a part where hydrogen concentration in gas introduced is high may become smaller than other parts.

[Claim 4]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, An exhaust water matter processing unit of a fuel cell constituting the above-mentioned catalyst body so that support area of a catalyst per unit volume of a part where hydrogen concentration in gas introduced is high may become smaller than other parts.

[Claim 5]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid

polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, An exhaust water matter processing unit of a fuel cell, wherein a catalyst holding amount per unit area of a part where hydrogen concentration in gas introduced is high constitutes the above-mentioned catalyst body so that it may become less than other parts.

[Claim 6]Claims 1-5 which the above-mentioned catalyst body supported a catalyst to a carrier of honeycomb structure, and made thickness of a passage wall of the above-mentioned carrier of a part where hydrogen concentration in the above-mentioned gas introduced is high thicker than other parts are the exhaust water matter processing units of a fuel cell of a description either.

[Claim 7]Claims 1-5 which the above-mentioned catalyst body supported a catalyst to a carrier of honeycomb structure, and enlarged passage sectional areas of the above-mentioned carrier of a part where hydrogen concentration in the above-mentioned gas introduced is high are the exhaust water matter processing units of a fuel cell of a description either.

[Claim 8]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, An exhaust water matter processing unit of a fuel cell constituting the above-mentioned catalyst body so that hydrogen treatment capability per unit volume of a part to which hydrogen concentration in gas introduced fell rapidly may become larger than other parts.

[Claim 9]An exhaust water matter processing unit of the fuel cell according to claim 8 with more [ hydrogen concentration in gas by which the above-mentioned catalyst body supports a catalyst to a carrier of honeycomb structure, and the above-mentioned introduction is carried out ] catalyst holding amounts per unit area of a part to which it fell rapidly than other parts.

[Claim 10]An exhaust water matter processing unit of the fuel cell according to claim 8 with a larger support area of a catalyst per unit volume of a part to which the above-mentioned catalyst body supported a catalyst to a carrier of honeycomb structure, and hydrogen concentration in the above-mentioned gas introduced fell rapidly than other parts.

[Claim 11]Claims 1-10 which constitute the above-mentioned catalyst body using a carrier of honeycomb structure of the product made from ceramics or metal are the exhaust water matter processing units of a fuel cell of a description either.

[Claim 12]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, An exhaust water matter processing unit of a fuel cell characterized by arranging a catalyst body using metal carriers to the downstream while dividing the above-mentioned catalyst body in the direction of a gas flow at plurality and arranging a catalyst body using a carrier made from ceramics to the upstream.

[Claim 13]Claims 1-12 which carried out emission gas from the above-mentioned air pole for an installed position of the above-mentioned catalyst body in an ejection passage for [ to the atmosphere ] emitting are the exhaust water matter processing units of a fuel cell of a description either.

[Claim 14]Claims 1-12 which are in an ejection passage for [ to the atmosphere ] emitting about

emission gas from the above-mentioned air pole, and carried out an installed position of the above-mentioned catalyst body near the injection hole to the atmosphere are the exhaust water matter processing units of a fuel cell of a description either.

[Claim 15]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, A hydrogen ejection passage for leading emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side to the above-mentioned catalyst body, Opening and closing of an opening and closing means which opens and closes the above-mentioned hydrogen ejection passage, and the above-mentioned opening and closing means are controlled, Establish a control means which introduces into the above-mentioned catalyst body emission gas which opens the above-mentioned hydrogen ejection passage wide periodically, and contains the above-mentioned hydrogen, and the above-mentioned control means, An exhaust water matter processing unit of a fuel cell performing control which introduces emission gas which repeats opening and closing of the above-mentioned opening and closing means for a short time, and contains the above-mentioned hydrogen intermittently during a pre-heating period of the above-mentioned catalyst body.

[Claim 16]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, While having a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out and providing a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body, An exhaust water matter processing unit of a fuel cell considering it as structure which divides and introduces into two or more places of a gas flow direction of the above-mentioned catalyst body emission gas containing the above-mentioned hydrogen so that it may become the calorific value of a request of this passage of each part of the above-mentioned catalyst body.

[Claim 17]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, While having a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out and providing a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body, An exhaust water matter processing unit of a fuel cell having established two or more fork roads which divide and introduce emission gas containing the above-mentioned hydrogen at two or more places of a gas flow direction of the above-mentioned catalyst body in this passage, and constituting a fork road of these plurality so that each part of the corresponding above-mentioned catalyst body may serve as desired calorific value.

[Claim 18]In a fuel cell which arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole, It is a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side, While having a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out and providing a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body, Two or more fork roads which divide and introduce into two or more places of a gas flow

direction of the above-mentioned catalyst body emission gas containing the above-mentioned hydrogen are established in this passage, And an exhaust water matter processing unit of a fuel cell making a fork road of these plurality into structure where emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream is introduced.

[Claim 19]An exhaust water matter processing unit of the fuel cell according to claim 18 with which emission gas which changes a passage sectional area of two or more above-mentioned fork roads, and contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream was introduced.

[Claim 20]It is provided in an end of two or more above-mentioned fork roads, and an effective area product or number of feed ports for introducing into each part of the above-mentioned catalyst body emission gas containing the above-mentioned hydrogen is changed, An exhaust water matter processing unit of the fuel cell according to claim 18 with which emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream was introduced.

[Claim 21]Establish a passage switching means which controls an inflow of emission gas containing the above-mentioned hydrogen to two or more above-mentioned fork roads, and at the time of power generation of a fuel cell. An exhaust water matter processing unit of the fuel cell according to claim 18 for which a channel change is performed so that emission gas of emission gas which contains the above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body which the whole quantity is introduced mostly and contains the above-mentioned hydrogen also in the downstream of a gas flow direction of the above-mentioned catalyst body at the time of a power generation stop or starting may be introduced.

[Claim 22]Claims 1-21 which provided a vapor-liquid-separation member which becomes a front face of a gas flow direction of the above-mentioned catalyst body from a foam metal are the exhaust water matter processing units of a fuel cell of a description either.

[Claim 23]An exhaust water matter processing unit of the fuel cell according to claim 22 which provided a wrap shielding member for a part where the water of condensation exists in a front face of a gas flow direction of the above-mentioned vapor-liquid-separation member easily.

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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention]This invention is used suitably for home use or the dynamo for cars, and relates to the hydrogen treatment device for processing the hydrogen discharged from the fuel cell which takes out the electrical and electric equipment using the combination reaction of hydrogen and oxygen.

[0002]

[Description of the Prior Art]In order to cope with the problem of environmental pollution in recent years and global warming, the electromobile attracts attention as an alternative energy vehicle of low pollution. For example, although the electromobile carrying a storage battery is already contained in the stage of utilization, by the relation with the accumulation-of-electricity capability of a cell, storage battery type vehicles have problems, like mileage is comparatively short and charging time is long, and serve as hindrance of wide use. For this reason, development of fuel cell type vehicles serves as pressing need as an electromobile which can solve these problems.

[0003]Generally a fuel cell has a unit cell which has arranged the hydrogen pole and the air pole on both sides of a poly membrane, and generates electricity the fuel gas which contains hydrogen in a hydrogen pole by supplying air to an air pole. At this time, the reaction expressed with the following formula (1) and (2), respectively arises on two poles.

Hydrogen pole:  $\text{H}_2 \rightarrow 2\text{H}^+ + 2\text{e}^- \dots (1)$

Air pole:  $(1/2) \text{O}_2 + 2\text{H}^+ + 2\text{e}^- \rightarrow \text{H}_2\text{O} \dots (2)$

[0004]However, when it carries a fuel cell in vehicles that is, in a portable fuel cell, not having become a problem so much in the installation type fuel cell may pose a big problem. Processing of the hydrogen discharged from the fuel cell which carries pure water matter in one of them is mentioned. This originates in reducing hydrogen concentration, if some nitrogen in the water by which it is generated when generating electricity with a fuel cell, and the air used by an air pole passes a poly membrane and it mixes in the hydrogen pole side. Then, it will be necessary to discharge the mixed impurity and there is a method of replacing the gas by the side of a hydrogen pole from hydrogen for every fixed time as the example. In this case, since inflammable hydrogen is contained in the gas discharged by substitution, a certain processing of emitting into the atmosphere as it is is needed undesirably.

[0005]Here, there is the method of carrying out separate recovery of the hydrogen (or thing for which the nitrogen transmission film for separating nitrogen which is other ingredients in mixed gas is used) by using a hydrogen permeable film in an analyzer etc. conventionally as a disposal method of the mixed gas containing hydrogen. How a burner is attached and combustion removes hydrogen as a general method of detoxicating and discharging hydrogen can be considered.

[0006]

[Problem(s) to be Solved by the Invention]However, there is much gas volume discharged from a fuel cell extraordinarily compared with the quantity which an analyzer etc. treat, and there is a



problem on which pressure loss increases and power increases. The method of attaching a burner has a problem which NO<sub>x</sub> generates by carrying out high temperature combustion by a burner, and the method of processing exhaust water matter more safely and cleanly is demanded.

[0007]At the time of power generation, moisture is contained so much in the gas discharged from a fuel cell. On the other hand, the gas which does not contain moisture depending on operational status and which contains a lot of hydrogen at high concentration may be discharged. For example, since the gas which does not contain moisture compared with the gas which contains moisture so much burns easily when hydrogen is burned and it processes, there is a possibility that temperature may rise too much.

[0008]Then, hydrogen in the gas by which this invention is discharged from a fuel cell in the fuel cell used as fuel in pure water matter, It aims at providing the exhaust water matter processing unit which faults, such as overheating, do not produce, even if it can process safely and promptly and changes hydrogen and the moisture content in emission gas further according to operational status, without emitting as it is into the atmosphere.

[0009]

[Means for Solving the Problem]This invention is a portable fuel cell [ like / for vehicles ], and proposes a simple device for processing safely emission gas containing hydrogen water and nitrogen mixed and it became impossible to use for power generation in a fuel cell of a type which stores and carries hydrogen gas in storage means, such as a tank and an occlusion alloy. And sufficient oxygen to oxidize emission gas which contains hydrogen discharged from the hydrogen pole side in emission gas discharged from the air pole side of a fuel cell being contained, and hydrogen found out that a processing unit which makes oxygen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out at ordinary temperature since catalyzed combustion is possible was effective. The rate of combustion of hydrogen was dramatically quick at that time, and it noted that the reaction velocity produced an exponential reaction which continues a fall gently after a reaction progresses quickly and hydrogen concentration falls rapidly immediately after touching that it is greatly dependent on temperature, therefore a catalyst. In order to maintain a reaction, drying a damp catalyst surface, While predetermined hydrogen quantity was required, paying attention to falling rather than the time of discharge of dry gas with little moisture, catalyst temperature considered optimal catalyst body composition and hydrogen ejection passage composition according to operational status, and reached this invention provided with the following means.

[0010]That is, this invention Claim 1 arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and proposes a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side in a fuel cell which generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole. This device is provided with a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, and structure of the above-mentioned catalyst body is changed according to hydrogen concentration distribution in gas introduced.

[0011]Since catalyzed combustion of the hydrogen is carried out using the above-mentioned catalyst body according to the above-mentioned composition, NO<sub>x</sub> does not occur like [ in a case of carrying out high temperature combustion by a burner ]. Since emission gas containing oxygen discharged from the above-mentioned air pole side is used as susceptibility-of-substances-to-burn gas, a new susceptibility-of-substances-to-burn gas supply device is unnecessary. Hydrogen concentration distribution in the above-mentioned catalyst body is not constant, and it is usually the highest in a catalyst inlet part, and since it is easy to carry out a rise in heat, heat generated by this part is absorbed, for example, Or if structure of the above-mentioned catalyst body is changed according to hydrogen concentration distribution so that generation of heat may be controlled, a local rise in heat can be prevented. Therefore, hydrogen can be safely processed efficiently with simple composition.

[0012]As other composition for solving an aforementioned problem, a device of Claim 2, It has a

catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, and the above-mentioned catalyst body is constituted so that calorific capacity per [ in a part where hydrogen concentration in gas introduced is high ] volume may become higher than other parts.

[0013] Since hydrogen concentration distribution in the above-mentioned catalyst body is the highest and it is usually easy to carry out a rise in heat in a catalyst inlet part as described above, if calorific capacity of this part is made higher than other parts, heat generated in a catalyst surface can be absorbed and partial overheating of a catalyst body can be prevented. Therefore, hydrogen can be safely processed efficiently with simple composition.

[0014] As other composition for solving an aforementioned problem, like Claim 3, while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, The above-mentioned catalyst body can also be constituted so that calorific value per unit volume in a part where hydrogen concentration in gas introduced is high may become smaller than other parts.

[0015] According to the above-mentioned composition, hydrogen concentration in the above-mentioned catalyst body is high, and partial overheating of a catalyst body can be similarly prevented by making small calorific value of a part where a rapid rise in heat breaks out easily. Therefore, a safe and efficient hydrogen treatment device is obtained with simple composition.

[0016] As other composition for solving an aforementioned problem, like Claim 4, while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, The above-mentioned catalyst body can also be constituted so that support area of a catalyst per unit volume in a part where hydrogen concentration in gas introduced is high may become smaller than other parts.

[0017] According to the above-mentioned composition, hydrogen concentration in the above-mentioned catalyst body is high, and partial overheating of a catalyst body can be similarly prevented by making it small, catalyst support area, i.e., a heat generation surface product, of a part where a rapid rise in heat breaks out easily. Therefore, a safe and efficient hydrogen treatment device is obtained with simple composition.

[0018] Or while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side like Claim 5 in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, A catalyst holding amount per unit area of a part where hydrogen concentration in gas introduced is high can also constitute the above-mentioned catalyst body so that it may become less than other parts. Even if it does in this way, same effect of making calorific value small and preventing partial overheating of a catalyst body is acquired.

[0019] Thickness of a passage wall of the above-mentioned carrier in a part where hydrogen concentration in gas by which the above-mentioned introduction is specifically carried out like Claim 6 considering the above-mentioned catalyst body as composition which supported a catalyst to a carrier of honeycomb structure is high is made thicker than other parts. Since calorific capacity of this part becomes large and support area of a catalyst also becomes small by this, the calorific value itself can decrease and the above-mentioned effect can be acquired easily.

[0020] Or passage sectional areas of the above-mentioned carrier in a part where hydrogen concentration in gas by which the above-mentioned introduction is carried out like Claim 7 considering the above-mentioned catalyst body as composition which supported a catalyst to a carrier of honeycomb structure is high may be enlarged. Since support area of a catalyst will become small and calorific value will decrease if it does in this way, the above-mentioned effect can be acquired easily.

[0021] While providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in a device of Claim 8 in emission gas containing the

above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, Hydrogen treatment capability per unit volume in a part to which hydrogen concentration in gas introduced fell rapidly constitutes the above-mentioned catalyst body so that it may become larger than other parts.

[0022]Hydrogen concentration distribution in the above-mentioned catalyst body continues a fall gently after that, although it is the highest in a catalyst inlet part and a reaction usually progresses and decreases rapidly quickly. Then, if hydrogen concentration heightens throughput of a part which decrease in number slowly, the length of a gas flow direction of a catalyst body can be shortened, and a miniaturization can be attained. Although there is a possibility that it may be discharged while hydrogen has not fully reacted, when hydrogen begins to flow, that is, catalyst temperature is low and activity is low, in the usual throughput, aggravation of exhaust emission can be prevented by providing a high part of throughput. And at the time of regular, since it is a low part of hydrogen concentration distribution, even if it makes throughput high, reaction fever occurs more than needed and it does not become overheating. On the contrary, since a catalyst inlet part of the upstream will be activated with that radiation and heat transfer if a reaction begins to progress by this part at the time of a standup, controlling partial overheating, the whole catalyst body can be activated and it can process efficiently.

[0023]The above-mentioned catalyst body is specifically considered as composition which supported a catalyst to a carrier of honeycomb structure like Claim 9, hydrogen concentration in the above-mentioned gas introduced is making more than other parts a catalyst holding amount per unit area in a part to which it fell rapidly, and the amount of hydrogen reactions per unit area is made to increase. If it does in this way, the length of a gas flow direction of a catalyst body required even for a predetermined level to reduce hydrogen concentration is shortened, and it can miniaturize. That is, after hydrogen of most in emission gas reacts at a stretch, hydrogen concentration in emission gas becomes low, a concentration gradient of gas and a catalyst surface becomes small, and also when gas carries out cubical expansion by generation of heat of hydrogen, the rate of flow increases. Then, in order that hydrogen may not carry out a deer reaction gradually, a little hydrogen quantity will come out, and nevertheless processing will take a certain considerable distance, but this is avoided by having the above-mentioned composition, and a large device is obtained in throughput by miniaturization.

[0024]Or while considering the above-mentioned catalyst body as composition which supported a catalyst to a carrier of honeycomb structure like Claim 10, it may be made for support area of a catalyst per unit volume in a part to which hydrogen concentration in gas introduced fell rapidly to become larger than other parts. Even if it does in this way, same effect is acquired, a fall of a reaction by hydrogen concentration inclination and a gas flow rate is prevented, and a device in which it is small and throughput is large can be realized.

[0025]Like Claim 11, the above-mentioned catalyst body can be constituted using a carrier of honeycomb structure of the product made from ceramics, or metal, for example. Mass production which used a mold is possible for a ceramic honeycomb carrier, and cost reduction is possible for it. Even if a metallic honeycomb carrier piles up a metaled corrugated panel and a plate, is created, and can process a corrugated panel easily with a gear gear and also it uses the same corrugated panel, since change of mountain height etc. is easy, it is easy to manufacture it and it is cheap. In a product made from ceramics, since it is necessary to roll a ceramic sheet which supports a periphery so that a crack may not arise in thermal expansion, and it is hard to produce a short carrier to a longitudinal direction, in such a case, if it is metal, it is advantageous.

[0026]In order to solve an aforementioned problem, while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in a device of Claim 12 in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, the above-mentioned catalyst body is divided in the direction of a gas flow at plurality, and it is considered as construction material different, respectively. When a catalyst body using a carrier made from ceramics is arranged to the upstream and a catalyst body using metal carriers is arranged to that downstream at this time, while making moisture in gas introduced into the above-mentioned

catalyst body stick to a ceramic carrier, it can be made to dry by conduction and radiation of heat which were generated in a metal carrier part.

[0027] Since a lot of steams are usually contained, moisture is absorbed by catalyst surface, and a reaction does not progress to gas discharged from an air pole of a fuel cell during power generation, but there is a possibility that emission immediately after discharge of hydrogen may get worse in it. Then, since an inflow of moisture to the downstream is suppressed and it becomes a dry gas by using a ceramic carrier for the upstream and making moisture absorb like the above-mentioned composition, a reaction is started promptly. Since the downstream was made into a metal carrier, local overheating can be prevented from distributing heat generated rapidly throughout a carrier with sufficient heat conduction, and arising near the entrance of a metal carrier part. If a reaction is started in a metal carrier part, since it dries with heat from a metal carrier part, the ceramic carrier part which absorbed moisture can absorb enough moisture discharged from an air pole by the following hydrogen discharge.

[0028] Like Claim 13, an installed position of the above-mentioned catalyst body is good to carry out emission gas from the above-mentioned air pole in an ejection passage for [ to the atmosphere ] emitting. Discharge of hydrogen from the above-mentioned hydrogen pole is not continuous, usually sets a certain time interval, and is discharged (it is once in 10 minutes). On the other hand, from the above-mentioned air pole, since gas is always discharged, the above-mentioned catalyst body can be cooled using while hydrogen is not discharged by always contacting the above-mentioned catalyst body to this emission gas. Therefore, increase of hydrogen quantity which there is [ hydrogen quantity ] no necessity for controlling an exhaust water quantum etc. in order to avoid excessive temperature up of the above-mentioned catalyst body, and makes it burn per time is possible. By installing the above-mentioned catalyst body in an ejection passage established permanently at a fuel cell conventionally, an equipment configuration is simplified and space-saving-ization can be attained.

[0029] It is good to be in the above-mentioned ejection passage, and to carry out an installed position of the above-mentioned catalyst body near the injection hole to the atmosphere like Claim 14, suitably. Thereby, a moisture content per unit volume of gas introduced can be reduced. That is, in a fuel cell, since gas which made an inside a pressurization state and became saturated steam mostly is introduced and is burned in order to raise generation efficiency, gas containing a lot of steams is discharged. In an ejection passage, a pressure of gas becomes low, and it can introduce into the above-mentioned catalyst body in the near state in a businesslike manner, and becomes difficult to solidify moisture on a catalyst surface from there being many moisture contents which can be held as a gas, so that it is close to an exit. Therefore, a collision opportunity of a catalyst and a steam is reduced and time to a combustion start of a catalyst can be shortened.

[0030] In order to process hydrogen with a device provided with a catalyst body which makes emission gas which contains oxygen discharged from the above-mentioned air pole side like Claim 15 susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, specifically, An opening and closing means which opens and closes a hydrogen ejection passage and the above-mentioned hydrogen ejection passage for leading emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side to the above-mentioned catalyst body, and a control means which introduces into the above-mentioned catalyst body emission gas which controls opening and closing of the above-mentioned opening and closing means, opens the above-mentioned hydrogen ejection passage wide periodically, and contains the above-mentioned hydrogen are established. This control means performs control which introduces emission gas which repeats opening and closing of the above-mentioned opening and closing means for a short time, and contains the above-mentioned hydrogen intermittently during a pre-heating period of the above-mentioned catalyst body.

[0031] When introducing into the above-mentioned catalyst body emission gas which opens the above-mentioned hydrogen ejection passage wide periodically, and contains the above-mentioned hydrogen, in order to activate a catalyst, control which introduces a small amount of hydrogen, makes it activated, and discharges hydrogen of a stipulated amount after that first is considered easily, but. Reaction sufficient in this for a catalyst to which it is exposed to a steam

and activity is falling cannot be occurred, but emission gets worse. On the other hand, when a constant rate of some hydrogen is discharged very much for a short time, in order that a part of catalyzed combustion may break out, a part of supplied hydrogen is purified. If hydrogen of the specified quantity is discharged after repeating this two or more times, a catalyst can be used in high activity from the first stage, and it can prevent suppressing emission low.

[0032]A device of Claim 16 is a device for processing emission gas containing hydrogen discharged from the hydrogen pole side of a fuel cell, and is provided with a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out. In this device, it was considered as structure which divides and introduces into it emission gas containing the above-mentioned hydrogen at two or more places of a gas flow direction of the above-mentioned catalyst body so that it may become the calorific value of a request of this passage of each part of the above-mentioned catalyst body while establishing a passage for introducing emission gas containing the above-mentioned hydrogen in the above-mentioned catalyst body.

[0033]In the above-mentioned composition, instead of changing structure of the above-mentioned catalyst body, structure of a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body is changed so that each part of the above-mentioned catalyst body may serve as desired calorific value. Since it can adjust with hydrogen quantity introduced, if calorific value of each part of the above-mentioned catalyst body carries out division supply of the emission gas containing the above-mentioned hydrogen to each part and each amount of supply is adjusted, it can prevent a local rise in heat and can process hydrogen efficiently safely with simple composition.

[0034]A device of Claim 17 provides two or more fork roads which divide and introduce into it emission gas containing the above-mentioned hydrogen at this passage at two or more places of a gas flow direction of the above-mentioned catalyst body while establishing a passage for introducing emission gas containing the above-mentioned hydrogen in the above-mentioned catalyst body. And a fork road of these plurality is constituted so that each part of the corresponding above-mentioned catalyst body may serve as desired calorific value.

[0035]If emission gas containing the above-mentioned hydrogen is specifically introduced into each part of the above-mentioned catalyst body from two or more above-mentioned fork roads, a gas mass flow introduced into each part of the above-mentioned catalyst body can be adjusted by changing shape of each fork road, etc. Therefore, it can be considered as calorific value of a request of each part of the above-mentioned catalyst body, a local rise in heat etc. can be prevented, and it can be safely considered as an efficient hydrogen treatment device.

[0036]A device of Claim 18 provides a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body, and provides two or more fork roads which divide and introduce emission gas which contains the above-mentioned hydrogen in two or more places of a gas flow direction of the above-mentioned catalyst body at this passage. Let a fork road of these plurality be the structure where emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream is introduced.

[0037]Since gas having contained many steams is discharged at the time of the usual power generation, a catalyst surface gets wet and a reaction becomes difficult to occur, but. By having passage composition into which emission gas which contains much above-mentioned hydrogen by the upstream of the above-mentioned catalyst body is introduced, it is made to generate heat intensively in an upstream catalyst body, and a catalyst can be activated promptly. Although it becomes gas with few water vapor contents with high hydrogen concentration at the time of a power generation stop and starting, since gas is introduced also into a catalyst body of the downstream by two or more above-mentioned fork roads, it is made to generate heat by the whole catalyst body, and it becomes possible to perform processing with sufficient safety and efficiency.

[0038]Specifically like Claim 19, a passage sectional area of two or more above-mentioned fork roads is changed. For example, a passage sectional area of a fork road corresponding to the

upstream of the above-mentioned catalyst body is enlarged, ventilation resistance is made small, and emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream can be introduced. [0039] Or like Claim 20, it is provided in an end of two or more above-mentioned fork roads, and an effective area product or number of feed ports for introducing into each part of the above-mentioned catalyst body emission gas containing the above-mentioned hydrogen can also be changed. For example, since gas volume introduced will increase greatly an effective area product of the above-mentioned feed port if a number is increased, emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream can be introduced.

[0040] A passage switching means which controls by composition of the above-mentioned paragraph 21 an inflow of emission gas containing the above-mentioned hydrogen to two or more above-mentioned fork roads is established. and emission gas which contains the above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body at the time of power generation of a fuel cell — a channel change being performed and at the time of a power generation stop or starting so that the whole quantity may be introduced mostly. It is characterized by performing a channel change so that emission gas which contains the above-mentioned hydrogen also in the downstream of a gas flow direction of the above-mentioned catalyst body may be introduced.

[0041] emission gas which gas having contained many steams is discharged at the time of power generation, opens only a fork road which introduces gas into the upstream of the above-mentioned catalyst body, for example since temperature of a catalyst body does not rise as easily as dry gas, and contains the above-mentioned hydrogen — the whole quantity can be mostly supplied to an upstream part, and temperature can be raised promptly. On the other hand, at the time of a power generation stop and starting, since [ that hydrogen concentration is high ] there are few water vapor contents, if it also opens a fork road which introduces gas into the downstream of the above-mentioned catalyst body and is made to generate heat by the whole catalyst body, it can process efficiently more safely.

[0042] In composition of the above-mentioned paragraph 22, a vapor-liquid-separation member which becomes a front face of a gas flow direction of the above-mentioned catalyst body from a foam metal is provided. Since specific surface area is dramatically large, on the surface, the foam metal can make moisture in emission gas able to condense positively, and can be removed. Since moisture in emission gas will condense within the above-mentioned catalyst body and a catalyst surface will not be wet if it does in this way, catalytic reaction is promoted and efficient processing is attained.

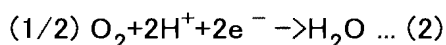
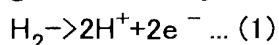
[0043] In composition of the above-mentioned paragraph 23, a wrap shielding member is provided for a part where the water of condensation exists in a front face of a gas flow direction of the above-mentioned vapor-liquid-separation member easily. Since a pickpocket omission will arise if gas containing hydrogen flows into a part to which a catalyst got wet with the water of condensation, by providing a vapor-liquid-separation member so that a water-of-condensation ball and a cone part may be covered, a pickpocket omission can be prevented and hydrogen can be processed certainly.

[0044]

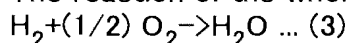
[Embodiment of the Invention] Hereafter, Drawings explain a 1st embodiment of this invention. It is a figure in which drawing 1 shows the outline composition of the fuel cell system for cars, and the exhaust water matter processing unit 2 with which it was connected and the air supply means 31 of an air pump etc. and the hydrogen storage means 32 of a high voltage compressed water matter tank etc. equipped the ejection passage 4 with the catalyst body 22 is installed by the fuel cell 1. The air pole (anode) 13 which formed the fuel cell 1 in the solid polyelectrolyte membrane 12 and the surface of one of these, It has the unit cell 11 which consists of the hydrogen pole (negative pole) 14 provided on the surface of another side as the principal part, and is constituted by laminating a large number via the separator (figure abbreviation) in which the slot used as a gas passageway was formed on the surface which touches an electrode in this unit cell 11. The silencer 5 is installed in the upstream of the exhaust water matter processing

unit 2.

[0045]The proton conductivity solid polyelectrolyte membrane of a fluoro-resin system is used for the solid polyelectrolyte membrane 12, for example. The material which combines conductivity and gas permeation nature, for example, carbon crossing, carbon paper, etc., is used for the air pole 13 and the hydrogen pole 14, and they can also be made to support the catalyst for promoting an electrode reaction. Similarly the hydrogen which the oxygen used by the air pole 13 is supplied as application-of-pressure air from the air supply means 31, and is used in the hydrogen pole 14 is supplied to the fuel cell 1 in the state of pressurized gas from the hydrogen storage means 32. At this time, when a hydrogen ion generates by the electrode reaction shown in a following formula (1), electrons are emitted, and when that electron moves to the air pole 13 side, it generates electricity in the hydrogen pole 14. A hydrogen ion passes along the inside of the polymer electrolyte membrane 12, and reaches the air pole 13, and water generates it by the electrode reaction shown in a following formula (2).



The reaction of the whole cell becomes like a formula (3).



[0046]Here, like the above-mentioned formula (1), it is decomposed into ion in the hydrogen pole 14, and hydrogen diffuses the inside of the solid polyelectrolyte membrane 12 to the air pole 13 side. Therefore, the emission gas from the hydrogen pole 14 a theory top, It becomes only hydrogen gas of the surplus which was not used by an electrode reaction, and this is circulated from the hydrogen storage means 32 to a hydrogen supply course using the hydrogen circulation means 33, such as a pump, and power generation should be able to be continued if the hydrogen to have been used in the hydrogen pole 14 considers it as the system made to newly supply. However, if operation which uses the hydrogen circulation means 33 and circulates hydrogen is actually continued in order that nitrogen and produced water by the side of the air pole 13 may flow into the hydrogen pole 14 side through the solid polyelectrolyte membrane 12, the hydrogen concentration by the side of the hydrogen pole 14 will fall with a previous impurity. Then, in order to maintain hydrogen concentration more than fixed, hydrogen substitution which discharges the gas by the side of the hydrogen pole 14 periodically, and introduces hydrogen is performed.

[0047]The hydrogen ejection passage 41 which connects the hydrogen circulation means 33 and the ejection passage 4 is specifically formed, and the opening and closing means 34 of an electro-magnetic valve etc. is installed in this hydrogen ejection passage 41. Opening and closing of the hydrogen ejection passage 41 by an opening and closing means can be controlled using the control means 35, for example, open the hydrogen ejection passage 41 wide for several seconds once in [ in 10 minutes ], and discharge the emission gas containing hydrogen to the ejection passage 4. The details of the control at the time of this periodical hydrogen discharge are mentioned later. It is a passage for emitting to the atmosphere the emission gas containing the oxygen discharged from the air pole 13 side, and by this invention, the ejection passage 4 is introduced into the exhaust water matter processing unit 2 by making into susceptibility-of-substances-to-burn gas the emission gas containing this oxygen, and after carrying out catalyzed combustion of the emission gas containing hydrogen and reducing hydrogen concentration enough, it is discharged. Since the emission gas containing the oxygen discharged from the air pole 13 side is always discharged during operation, the catalyst body 22 in the exhaust water matter processing unit 2 which became an elevated temperature by generation of heat by discharge of hydrogen is cooled to gas temperature by the following hydrogen discharge.

[0048]As shown in a figure, when forming the silencer 5, it is desirable to arrange the exhaust water matter processing unit 2 to the downstream of the silencer 5. This is to become low-pressure power and for the moisture content per unit volume of gas to decrease so that the inside of the ejection passage 4 is close to the injection hole like the downstream (i.e., the atmosphere). By this invention, although common burners, such as a burner, are arranged from viewpoints of a noise reduction etc. at the upstream of the silencer 5 in many cases, in order to



carry out catalyzed combustion at low temperature comparatively, they are the purposes of avoiding the temperature fall by generating of the water of condensation, etc., and are installed in the above-mentioned position. By installing the silencer 5 in the upstream, the emission gas containing hydrogen and the emission gas containing oxygen are mixed good within the silencer 5, are introduced in the exhaust water matter processing unit 2, and also have an advantage which raises combustor efficiency.

[0049]The exhaust water matter processing unit 2 allocates the catalyst body 22 for carrying out catalyzed combustion of the hydrogen in the cylindrical container 21. The upstream catalyst object 201 in which the catalyst body 22 is located in the upstream of a gas flow as details are shown in drawing 2. It is divided by the downstream catalyst object 202 located in the downstream, and these catalyst bodies 201 and 202 support a catalyst to the carrier of the honeycomb structure which has a passage of a large number parallel to the flow direction of gas, and are formed in it by each. Here, in this embodiment, the passage wall 211 of the upstream catalyst object 201 forms so that it may become thicker than the passage wall 212 of the downstream catalyst object 202. The cross-section area of the passage of the upstream catalyst object 201 and the passage of the downstream catalyst object 202 and the catalyst holding amount per unit area presuppose that it is the same.

[0050]At this time, as for the upstream catalyst object 201 which thickened wall thickness, the calorific capacity per unit area becomes larger than the downstream catalyst object 202. On the other hand, as for the heat generation surface product per unit volume, i.e., the support area of a catalyst, since the surface area of each passage will become small if wall thickness is thick, the direction of the upstream catalyst object 201 becomes smaller than the downstream catalyst object 202. Although the hydrogen concentration in the emission gas introduced into the catalyst body 22 is the highest in the upstream end near an entrance, therefore calorific value also increases easily, by this embodiment, calorific capacity of this portion is enlarged, and since heat was made easy to absorb, excessive temperature up is prevented. Since support area (holding amount) of the catalyst was made small, the heat itself to generate becomes small.

[0051]The longitudinal direction length of the upstream catalyst object 201 and the downstream catalyst object 202 sets up as follows. Generally, the hydrogen concentration distribution in the catalyst body 22 is the highest at an inlet section, and after a reaction progresses and decreases rapidly quickly, it continues a fall gently. That is, when the wall thickness of a catalyst body is constant, as a dotted line shows to drawing 3, hydrogen contacts a catalyst by the upstream (field shown in a figure by x) of the catalyst body 22, a reaction progresses quickly, and catalyst body 22 temperature also rises abruptly (when wall thickness of the upstream catalyst object 201 is not thickened), but. Subsequently, catalyst body 22 temperature also decreases rapidly with reduction in hydrogen concentration. In the downstream (field shown in a figure by y) of the catalyst body 22, like hydrogen concentration, temperature falls gently and it becomes target temperature mostly in the distance y. Then, like drawing 2, it is made to correspond to these [ x and y ], and length [ of the longitudinal direction of the upstream catalyst object 201 and the downstream catalyst object 202 ] x and y are set up. By carrying out like this, gas with high concentration continues being supplied and it becomes possible to suppress low the temperature of the field x where catalyst body temperature is comparatively high.

[0052]In manufacturing the catalyst body 22 of the above-mentioned structure, first ceramics, such as zirconia, by the usual method die forming and by calcinating, producing the carrier of specified shape and being immersed in a catalyst solution, It is made to stick and what is necessary is just to unify, after manufacturing the upstream catalyst object 201 and the downstream catalyst object 202 to a different body, respectively. Although ceramic carriers, such as zirconia, have an advantage which shaping is easy and tends to mass-produce, not only this but metal carriers for example, can also be used for the construction material of a carrier. The metal carrier cannot contain moisture easily, and since heat conduction is good, it can do concentration distribution few.

[0053]The operation of this embodiment is explained below. From the air supply means 31, it will react, as shown in the above-mentioned formula (1) and (2), and air will be generated to it, if hydrogen is supplied from the hydrogen storage means 32 to the fuel cell 1 of drawing 1. The

hydrogen supplied from the hydrogen storage means 32 circulates by the circulation means 33, and only the hydrogen quantity consumed by real power generation is supplied from the hydrogen storage means 32. However, since it becomes impossible to use it for power generation while circulating when nitrogen and a steam mix from the air pole 13, hydrogen concentration falls and below fixed concentration becomes, the opening and closing means 34 is opened, it discharges from the hydrogen ejection passage 41 to the ejection passage 4, catalyzed combustion is carried out within the exhaust water matter processing unit 2, and it is considered as clean gas.

[0054]The hydrogen introduced into the catalyst body 22 burns considering the gas containing the oxygen discharged from the air pole 13 as susceptibility-of-substances-to-burn gas. Here, as mentioned above, generally the hydrogen concentration distribution in the catalyst body 22 is the highest at an inlet section, and a reaction progresses and carries out a rise in heat quickly, but the catalyst body 22 makes wall thickness of the upstream catalyst object 201 thicker than the downstream catalyst object 202, and since calorific capacity is large, it tends to absorb heat. Since catalyst support area is small, the calorific value itself can be controlled.

[0055]Although the calorific capacity of a catalyst body seldom influences at the time of steady operation, when the gas which contains hydrogen like this device is supplied intermittently and accompanied by big generation of heat for a short time, it can control excessive generation of heat by using the upstream catalyst object 201 of the catalyst body 22 as a heat-absorptive object. While the upstream catalyst object 201 with thick wall thickness absorbs heat compared with the case where the effect is clear to drawing 3, and wall thickness is constant, when a heat generation surface product becomes small, the rise of catalyst body temperature becomes small and the maximum temperature is falling greatly. Since the hydrogen which did not react with the upstream catalyst object 201 burns, if it enters in the downstream catalyst object 202, it goes up again, and after that, catalyst body temperature will fall and will turn into the degree of about 1 constant temperature.

[0056]Thus, according to the above-mentioned composition, catalyzed combustion can be effectively carried out by the catalyst body 22 whole, controlling an excessive rise in heat, and exhaust water matter can be processed safely and efficiently. Since the exhaust water matter processing unit 2 was installed in the ejection passage 4 of the air pole 13, it is not necessary to form the new device for susceptibility-of-substances-to-burn gas supply, composition is simplified, and cost can be reduced.

[0057]Catalyst body 22 composition in a 2nd embodiment of this invention is shown in drawing 4. Although a 1st embodiment of the above showed the composition which controls the rise in heat paying attention to the point that the upstream catalyst object 201 serves as overheating easily, According to this embodiment, like drawing 4 (a), the catalyst holding amount per unit area of the downstream catalyst object 202 is made more than the upstream catalyst object 201, the combustor efficiency of the downstream catalyst object 202 is raised, and the miniaturization of the catalyst body 22 is attained. The upstream catalyst object 201 and the downstream catalyst object 202 are formed in one using the carrier of the same structure, and are the same. [ of passage sectional areas and wall thickness ]

[0058]In order to change a catalyst holding amount with the upstream catalyst object 201 and the downstream catalyst object 202 using the same carrier, catalyst concentration -- differing -- two -- a kind -- a catalyst solution -- preparing -- a carrier -- one side -- the end face -- from -- length -- x -- a portion -- low concentration -- a catalyst solution -- being immersed -- an upstream catalyst -- the body -- 201 -- carrying out -- while -- remaining -- length -- y -- ' -- a portion -- another side -- the end face -- a side -- from -- high concentration -- a catalyst solution -- being immersed -- a downstream catalyst -- the body -- 202 -- carrying out -- \*\*\*\*ing .

[0059]Generally, as shown in drawing 5 (b), the hydrogen concentration in the catalyst body 22 is the highest at an inlet section, a reaction progresses quickly and it decreases rapidly by the distance x, after that, continues a fall gently and turns into almost predetermined low concentration in the distance y. That is, when the catalyst holding amount per unit area of the upstream catalyst object 201 and the downstream catalyst object 202 is the same, in order for

below prescribed concentration to carry out hydrogen concentration, it is necessary to make the longitudinal direction length of the downstream catalyst object 202 into the length corresponding to the distance  $y$ , and the physique becomes large (drawing 5 (a)).

[0060]On the other hand, in this embodiment, there are many catalyst holding amounts of the downstream catalyst object 202, and since reactivity increases and temperature also rises easily, the amount of catalyzed combustion increases. Therefore, since hydrogen concentration can be made low enough and the length of the downstream catalyst object 202 can be shortened that much in distance  $y'$  shorter than the distance  $y$  like drawing 4 (b), the catalyst body 22 is made compact, and it is small and can be considered as the high device of throughput. By having heightened the throughput of the downstream catalyst object 202, hydrogen can begin to flow, that is, even when catalyst temperature is low and activity is low, the reaction of hydrogen can progress, and aggravation of emission can be prevented. And since the hydrogen concentration distribution at the time of regular is low, even if the downstream catalyst object 202 makes throughput high, reaction fever occurs more than needed and it does not serve as overheating. On the contrary, since the catalyst inlet part of the upstream will be activated with that radiation and heat transfer if a reaction begins to progress by this part at the time of a standup, controlling partial overheating, the whole catalyst body can be activated and it can process efficiently.

[0061]Catalyst body 22 composition in a 3rd embodiment of this invention is shown in drawing 6. The upstream catalyst object 201 and the downstream catalyst object 202 are constituted from this embodiment using the carrier from which structure differs, and like drawing 6 (a), passage sectional areas are smaller than the upstream catalyst object 201, and let the carrier of the downstream catalyst object 202 be the carrier which also formed wall thickness thinly. The catalyst holding amount per unit area presupposes that it is the same with the upstream catalyst object 201 and the downstream catalyst object 202.

[0062]Since catalyst body temperature becomes high easily since the downstream catalyst object 202 of calorific capacity with thin wall thickness is small according to the above-mentioned composition, and a reaction constant becomes large, a throughput increases. Passage sectional areas are small and that the heat generation surface product per unit volume (catalyst support area) becomes large also contributes to the increase in the amount of catalyzed combustion. Therefore, like a 2nd embodiment of the above, can shorten the length of the longitudinal direction of the downstream catalyst object 202 with  $y'$ , and at the time of a standup. While the reaction of hydrogen progresses with the downstream catalyst object 202 and preventing aggravation of emission, the effect which promotes activation of the upstream catalyst object 201 is acquired.

[0063]Catalyst body 22 composition in a 4th embodiment of this invention is shown in drawing 7. The upstream catalyst object 201 and the downstream catalyst object 202 are constituted from this embodiment using the carrier from which structure differs, like drawing 7 (a), ceramic carriers, such as zirconia, are used for the upstream catalyst object 201, and a metal carrier is used for the downstream catalyst object 202. Even if \*\*\*\*\* which constitutes the downstream catalyst object 202 laminates in piles the plate 23 and the corrugated panel 24 which consist of metallic foils like drawing 7 (b), it rolls and carries out the time of what was piled up, and is good also as honeycomb shape. The downstream catalyst object 202 using a metal carrier has wall thickness thinner than the upstream catalyst object 201, and it is formed so that passage sectional areas may become small.

[0064]Rather than a ceramic carrier, since calorific capacity per unit volume can be made small, and it will be activable at an early stage and also a metal carrier will contact only gas with thin hydrogen concentration at the time of stationary burning also after the catalyst body 22 in early stages of operation has become wet if this is used for the downstream catalyst object 202, it does not have fear of overheating. On the other hand, since a lot of steams are usually contained in the gas discharged from the air pole of a fuel cell, moisture is absorbed by the catalyst surface and there is a possibility that a reaction may be checked in it, but. A ceramic carrier contributes to dry-ization of gas greatly, if this is used for the upstream catalyst object 201 in order for the carrier itself to absorb moisture. The absorbed moisture is dried by the

conduction and radiation of heat which are generated in the metal carrier of the downstream. [0065] Since the metal carrier can perform change of shape easily by changing the thickness of a metallic foil, the pitch of a corrugated panel, and a height of thread, when changing the calorific capacity and catalyst support area of a carrier with the upstream catalyst object 201 and the downstream catalyst object 202, manufacture becomes easy like this invention. In a ceramic carrier, maintenance can also manufacture and install short shape in the longitudinal direction which becomes difficult easily.

[0066] Drawing 8 is an example of the opening and closing control of the opening and closing means 34 by the control means 35 at the time of discharging the emission gas from the hydrogen pole 14 from the hydrogen ejection passage 41 to the ejection passage 4. In order to hold the hydrogen concentration of the hydrogen pole 14 more than fixed, it is necessary to open the opening and closing means 34 of an electro-magnetic valve etc., and to discharge the emission gas containing hydrogen periodically (it is once in 10 minutes), so that it may illustrate. At this time, as a dashed line shows among a figure, the method of discharging the whole quantity of predetermined gas volume at once is common, but. In this method, since the comparatively high gas of hydrogen concentration flows in the exhaust water matter processing unit 2 which the catalyst body 22 is not activating, the exhaust water matter concentration of a starting initial will exceed a desired value temporarily. After activation, the amount of catalyzed combustion increases and the catalyst body 22 serves as an elevated temperature easily.

[0067] For this reason, as a solid line shows among a figure, the control means 35 performs control which repeats opening and closing of the opening and closing means 34 for a short time, and hydrogen which is a grade which a catalyst activates is intermittently introduced in the exhaust water matter processing unit 2 during the pre-heating period of the catalyst body 22. Thus, a catalyst is effectively activable, while the catalyst surface which became wet with the steam is dried, it is activated in an instant and the exhaust water matter of a starting initial is stopped lower than a desired value by introducing to some extent high-concentration hydrogen gas for a short time very much. If the remaining hydrogen is discharged after the suitable number of times repeating this, catalyzed combustion can be performed efficiently and the device which was excellent in exhaust emission will be realized.

[0068] Thus, according to this invention, the simple and highly efficient exhaust water matter processing unit using the emission gas from the air pole 13 is realizable. The catalyst body 22 is using the comparatively high carrier of calorific capacity for the part to which overheating occurs easily, or changing a catalyst holding amount and a heat generation surface product, and cancels overheating easily. Or in the part in which hydrogen concentration and catalyst temperature are low, and hydrogen treatment efficiency is usually low, the miniaturization of the catalyst body 22 is enabled by increasing a catalyst holding amount and a heat generation surface product as composition which heightened throughput. Aggravation of the emission at the time of a standup and overheating can be prevented by optimizing the control method.

[0069] Even if it uses independently the composition and the control method of the upstream catalyst object 201 and the downstream catalyst object 202 which were shown by each above-mentioned embodiment, respectively, they may combine some according to the purpose and can perform still better exhaust water matter processing.

[0070] Although the hydrogen ejection passage 41 from the hydrogen circulation means 33 was connected to the ejection passage 4 of the exhaust water matter processing unit 2 upper stream and the emission gas containing hydrogen was introduced into the front face of the catalyst body 22 in each above-mentioned embodiment, The hydrogen ejection passage 41 is branched and it may be made to introduce into two or more parts of the catalyst body 22 the emission gas containing hydrogen, and it depends according to operational status and suitable processing is attained. The example is shown below.

[0071] Drawing 9 is the outline composition of the fuel cell system in a 5th embodiment of this invention. In this embodiment, the valve 37 is provided in the fuel cell system shown in above-mentioned drawing 1 in the middle of the passage reached [ from the hydrogen pole 14 ] to the hydrogen circulation means 33 in the valve 36 in the middle of the passage reached [ from the hydrogen storage means 32 ] to the fuel cell 1, respectively so that it may illustrate. Thereby,

when power generation is suspended, the valves 36 and 37 are closed, hydrogen is shut up in the fuel cell 1, and it becomes possible to avoid leakage and consumption of hydrogen from the hydrogen pole 14 side. However, the inside of the fuel cell 1 under power generation is a pressurization state, and since the air pole 13 side becomes atmospheric pressure soon after a stop to this, the mixed gas with which hydrogen moves to the air pole 13 side from the hydrogen pole 14 side according to a pressure differential, and two poles contain high-concentration hydrogen will be full. In this case, when rebooting the fuel cell 1, it will be necessary to pass hydrogen to the hydrogen pole 14 side, to pass air to the air pole 13 side, and to purge mixed gas.

[0072] So, in this embodiment, by the control means 35, after closing the valve 36 at the time of a power generation stop, the valve 37 is wide opened until the hydrogen pole 14 reaches atmospheric pressure, the opening and closing means 34 is opened, and the gas by the side of the hydrogen pole 14 is discharged to the hydrogen ejection passage 41. Thereby, the pressure differential between two poles can be canceled and mixing can be suppressed for gas to the minimum. If the hydrogen pole 14 becomes atmospheric pressure, the valve 37 and the opening and closing means 34 will be closed.

[0073] The emission gas by the side of the air pole 13 which hydrogen concentration is high and serves as susceptibility-of-substances-to-burn gas rather than the gas discharged during power generation is also few, and also [ an equivalent for an idling, and ] since the gas discharged at the time of this power generation stop does not contain the moisture generated by an electrode reaction, it is drying it. For this reason, if the whole quantity is introduced into the front face of the catalyst body 22, catalytic reaction will rise rapidly and will tend to cause overheating. By this embodiment, in order to avoid this, while trichotomizing and arranging the catalyst body 22 to a gas flow direction, the hydrogen ejection passage 41 is branched and it has composition into which the emission gas which contains hydrogen in the front face of the divided catalyst bodies 22A, 22B, and 22C from each fork roads 41A, 41B, and 41C, respectively is introduced. At this time, it is good to make it a gas introduction amount decrease more in the latter-part side where temperature becomes high in order that much gas may be supplied to the catalyst body 22A of the Mogami style from other catalyst bodies 22B and 22C and the combustion gas by the catalyst of the preceding paragraph may flow.

[0074] For example, the tube diameter of the pipe which constitutes the fork road 41A of the Mogami style is the largest, and it is made for the tube diameter of the downstream fork roads 41B and 41C to become small one by one in the composition shown in drawing 10. The path of the feed ports 42A, 42B, and 42C which carry out an opening to the end of each fork roads 41A, 41B, and 41C, and introduce gas into the catalyst bodies 22A, 22B, and 22 is made into an equal diameter here, and each number is set to one. Since the flow according to pipe inner pressure loss will blow off from a feed port if a fork road is constituted from a pipe with which tube diameters differ, much gas can be supplied for the upstream.

[0075] According to the above-mentioned composition, at the time of a power generation stop, even if dry gas with high hydrogen concentration is discharged comparatively so much for a short time, Since the gas which contains hydrogen in each of the divided catalyst bodies 22A, 22B, and 22C from the fork roads 41A, 41B, and 41C of the hydrogen ejection passage 41 is introduced, the catalyst body 22A of the Mogami style can be prevented from being overheated locally. Since the tube diameter of the fork roads 41A, 41B, and 41C is made small towards the lower stream from the upper stream like drawing 10, a gas introduction amount increases in the upstream and it was made for the downstream to decrease, when hot combustion gas flows, the catalyst bodies 22B and 22C of the downstream are not overheated. Drawing 11 shows the longitudinal direction distance of the exhaust water matter processing unit 2, and the relation of the temperature of combustion, and is made to generate heat by the catalyst body 22 whole, and catalyzed combustion of it can be carried out, preventing overheating. At the time of starting, although the gas which does not contain moisture is discharged immediately after a power generation start, overheating can be controlled similarly.

[0076] Since the gas having contained many steams is discharged at the time of the usual power generation, catalytic reaction becomes more difficult to occur than dry gas, but. Since the

catalyst body 22 was constituted so that much hydrogen might be supplied by the catalyst body 22A of the Mogami style rather than other catalyst bodies 22B and 22C, it generates heat intensively by the catalyst body 22A of the Mogami style, and the purification performance which rose and was promptly excellent in temperature is demonstrated. Thus, according to this embodiment, it can be used conveniently for all at the time during power generation of a power generation stop, catalytic reaction of the hydrogen in the emission gas with which states differ can be carried out safely and effectively, and emission can be suppressed low.

[0077] Drawing 12 and drawing 13 are other examples of the composition of the fork roads 41A, 41B, and 41C. For example, like drawing 12, when each tube diameter of the fork roads 41A, 41B, and 41C is made the same, a flow may be adjusted by changing the path or number of the feed ports 43A, 43B, and 43C which introduces the gas which contains hydrogen in the catalyst bodies 22A, 22B, and 22C. Here, the path of the feed port 43A of the catalyst body 22A of the Mogami style is made larger than other feed ports 43B and 43C. The number of the feed ports 43C of the catalyst body 22C of the lowest style is made less than other feed ports 43B and 43C. Even if it does in this way, the amount of blow off of the gas which contains hydrogen towards the lower stream from the upper stream decreases.

[0078] Or the tube diameter of the fork roads 41A, 41B, and 41C, the path of the feed ports 44A, 44B, and 44C, and a number are good like drawing 13 also as composition which presupposes that it is the same, forms the valve 6 in the hydrogen ejection passage 41 between the fork road 41A and the fork road 41B, and opens and closes the valve 6 according to operational status. That is, when processing the gas containing a steam which cannot react easily like [ at the time of the usual power generation ], the valve 6 is closed by the control means 35, and it is made for the whole quantity of the gas which contains hydrogen in the catalyst body 22A of the Mogami style from the feed port 44A of the fork road 41A to blow off. On the other hand, since it becomes gas with few water vapor contents with high hydrogen concentration immediately after a power generation stop, the control means 35 opens the valve 6 and the gas which contains hydrogen also in the catalyst bodies 22B and 22C of the downstream from the feed ports 44B and 44C of the fork roads 41B and 41C is introduced. In this composition, if form a means to detect the temperature of each catalyst bodies 22A, 22B, and 22C, that result is made to feed back and opening and closing of the valve 6 are controlled, it will become possible to perform processing in which can control the catalyst body 22 to a more uniform temperature, and it is safe for it, and efficient.

[0079] Gas temperature can be lowered locally and, moreover, moisture can be made to condense on the surface of the catalyst body 22A by supplying hydrogen gas of ordinary temperature to the catalyst body 22A mostly in the about 60–70 °C gas which has the above-mentioned composition and contains moisture. Therefore, the gas supplied to the downstream catalyst bodies 22B and 22C is dried as much as possible, and the effect to prevent can also expect that a catalyst serves as inertness.

[0080] Drawing 14 (a) and (b) shows exhaust water matter processing unit 2 composition in a 6th embodiment of this invention, and is [ the member ] close and arranges the vapor-liquid-separation member 7 which becomes a front face of the catalyst body 22 from a foam metal. The vapor-liquid-separation member 7 makes the moisture in the gas which is disc-like [ of the catalyst body 22 and an equal diameter ], is the surface of the foam metal whose specific surface area is very large, and is introduced condense positively. Caudad, the water of condensation falls and is removed by gravity. Thereby, when the catalyst body 22 has got cold, a catalyst surface gets wet with the water of condensation, and activity is prevented from falling. moreover — since a pickpocket omission will arise if the gas containing hydrogen flows into the part to which the catalyst became inertness with the water of condensation — a water-of-condensation ball — the catalyst body 22 cheap lower part — a wrap — the shielding member 8 of an approximate circle arc is allocated in the front face of the vapor-liquid-separation member 7 like. Since these vapor-liquid-separation member 7, the shielding member 8, and the catalyst body 22 of each other are arranged closely, if a reaction is started and the temperature of the catalyst body 22 rises, moisture will evaporate again and will be discharged.

[0081] The internal stoma is opening the foam metal of each other for free passage, and gas

circulates besides a flow parallel to a gas flow. Therefore, since the gas containing some hydrogen flows also into the part taken up with the shield 8 of the catalyst body 22 and catalytic reaction occurs, there are few rates which make the catalyst body 22 useless, and they end, and it becomes possible to perform a cleaning effect efficiently.

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[Translation done.]



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**TECHNICAL FIELD**

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[Field of the Invention]This invention is used suitably for home use or the dynamo for cars, and relates to the hydrogen treatment device for processing the hydrogen discharged from the fuel cell which takes out the electrical and electric equipment using the combination reaction of hydrogen and oxygen.

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[Translation done.]

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PRIOR ART

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[Description of the Prior Art]In order to cope with the problem of environmental pollution in recent years and global warming, the electromobile attracts attention as an alternative energy vehicle of low pollution. For example, although the electromobile carrying a storage battery is already contained in the stage of utilization, by the relation with the accumulation-of-electricity capability of a cell, storage battery type vehicles have problems, like mileage is comparatively short and charging time is long, and serve as hindrance of wide use. For this reason, development of fuel cell type vehicles serves as pressing need as an electromobile which can solve these problems.

[0003]Generally a fuel cell has a unit cell which has arranged the hydrogen pole and the air pole on both sides of a poly membrane, and generates electricity the fuel gas which contains hydrogen in a hydrogen pole by supplying air to an air pole. At this time, the reaction expressed with the following formula (1) and (2), respectively arises on two poles.

Hydrogen pole:  $H_2 \rightarrow 2H^+ + 2e^- \dots (1)$

Air pole:  $(1/2) O_2 + 2H^+ + 2e^- \rightarrow H_2O \dots (2)$

[0004]However, when it carries a fuel cell in vehicles that is, in a portable fuel cell, not having become a problem so much in the installation type fuel cell may pose a big problem. Processing of the hydrogen discharged from the fuel cell which carries pure water matter in one of them is mentioned. This originates in reducing hydrogen concentration, if some nitrogen in the water by which it is generated when generating electricity with a fuel cell, and the air used by an air pole passes a poly membrane and it mixes in the hydrogen pole side. Then, it will be necessary to discharge the mixed impurity and there is a method of replacing the gas by the side of a hydrogen pole from hydrogen for every fixed time as the example. In this case, since inflammable hydrogen is contained in the gas discharged by substitution, a certain processing of emitting into the atmosphere as it is is needed undesirably.

[0005]Here, there is the method of carrying out separate recovery of the hydrogen (or thing for which the nitrogen transmission film for separating nitrogen which is other ingredients in mixed gas is used) by using a hydrogen permeable film in an analyzer etc. conventionally as a disposal method of the mixed gas containing hydrogen. How a burner is attached and combustion removes hydrogen as a general method of detoxicating and discharging hydrogen can be considered.

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TECHNICAL PROBLEM

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[Problem(s) to be Solved by the Invention]However, there is much gas volume discharged from a fuel cell extraordinarily compared with the quantity which an analyzer etc. treat, and there is a problem on which pressure loss increases and power increases. The method of attaching a burner has a problem which NO<sub>x</sub> generates by carrying out high temperature combustion by a burner, and the method of processing exhaust water matter more safely and cleanly is demanded.

[0007]At the time of power generation, moisture is contained so much in the gas discharged from a fuel cell. On the other hand, the gas which does not contain moisture depending on operational status and which contains a lot of hydrogen at high concentration may be discharged. For example, since the gas which does not contain moisture compared with the gas which contains moisture so much burns easily when hydrogen is burned and it processes, there is a possibility that temperature may rise too much.

[0008]Then, hydrogen in the gas by which this invention is discharged from a fuel cell in the fuel cell used as fuel in pure water matter, It aims at providing the exhaust water matter processing unit which faults, such as overheating, do not produce, even if it can process safely and promptly and changes hydrogen and the moisture content in emission gas further according to operational status, without emitting as it is into the atmosphere.

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[Translation done.]

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**MEANS**

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[Means for Solving the Problem]This invention is a portable fuel cell [ like / for vehicles ], and proposes a simple device for processing safely emission gas containing hydrogen water and nitrogen mixed and it became impossible to use for power generation in a fuel cell of a type which stores and carries hydrogen gas in storage means, such as a tank and an occlusion alloy. And sufficient oxygen to oxidize emission gas which contains hydrogen discharged from the hydrogen pole side in emission gas discharged from the air pole side of a fuel cell being contained, and hydrogen found out that a processing unit which makes oxygen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out at ordinary temperature since catalyzed combustion is possible was effective. The rate of combustion of hydrogen was dramatically quick at that time, and it noted that the reaction velocity produced an exponential reaction which continues a fall gently after a reaction progresses quickly and hydrogen concentration falls rapidly immediately after touching that it is greatly dependent on temperature, therefore a catalyst. In order to maintain a reaction, drying a damp catalyst surface, While predetermined hydrogen quantity was required, paying attention to falling rather than the time of discharge of dry gas with little moisture, catalyst temperature considered optimal catalyst body composition and hydrogen ejection passage composition according to operational status, and reached this invention provided with the following means.

[0010]That is, this invention Claim 1 arranges a hydrogen pole and an air pole on both sides of solid polyelectrolyte membrane, and proposes a device for processing emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side in a fuel cell which generates electricity by supplying hydrogen gas to a hydrogen pole and supplying air to an air pole. This device is provided with a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, and structure of the above-mentioned catalyst body is changed according to hydrogen concentration distribution in gas introduced.

[0011]Since catalyzed combustion of the hydrogen is carried out using the above-mentioned catalyst body according to the above-mentioned composition, NOx does not occur like [ in a case of carrying out high temperature combustion by a burner ]. Since emission gas containing oxygen discharged from the above-mentioned air pole side is used as susceptibility-of-substances-to-burn gas, a new susceptibility-of-substances-to-burn gas supply device is unnecessary. Hydrogen concentration distribution in the above-mentioned catalyst body is not constant, and it is usually the highest in a catalyst inlet part, and since it is easy to carry out a rise in heat, heat generated by this part is absorbed, for example, Or if structure of the above-mentioned catalyst body is changed according to hydrogen concentration distribution so that generation of heat may be controlled, a local rise in heat can be prevented. Therefore, hydrogen can be safely processed efficiently with simple composition.

[0012]As other composition for solving an aforementioned problem, a device of Claim 2, It has a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, and the above-

mentioned catalyst body is constituted so that calorific capacity per [ in a part where hydrogen concentration in gas introduced is high ] volume may become higher than other parts.

[0013] Since hydrogen concentration distribution in the above-mentioned catalyst body is the highest and it is usually easy to carry out a rise in heat in a catalyst inlet part as described above, if calorific capacity of this part is made higher than other parts, heat generated in a catalyst surface can be absorbed and partial overheating of a catalyst body can be prevented. Therefore, hydrogen can be safely processed efficiently with simple composition.

[0014] As other composition for solving an aforementioned problem, like Claim 3, while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, The above-mentioned catalyst body can also be constituted so that calorific value per unit volume in a part where hydrogen concentration in gas introduced is high may become smaller than other parts.

[0015] According to the above-mentioned composition, hydrogen concentration in the above-mentioned catalyst body is high, and partial overheating of a catalyst body can be similarly prevented by making small calorific value of a part where a rapid rise in heat breaks out easily. Therefore, a safe and efficient hydrogen treatment device is obtained with simple composition.

[0016] As other composition for solving an aforementioned problem, like Claim 4, while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, The above-mentioned catalyst body can also be constituted so that support area of a catalyst per unit volume in a part where hydrogen concentration in gas introduced is high may become smaller than other parts.

[0017] According to the above-mentioned composition, hydrogen concentration in the above-mentioned catalyst body is high, and partial overheating of a catalyst body can be similarly prevented by making it small, catalyst support area, i.e., a heat generation surface product, of a part where a rapid rise in heat breaks out easily. Therefore, a safe and efficient hydrogen treatment device is obtained with simple composition.

[0018] Or while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side like Claim 5 in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, A catalyst holding amount per unit area of a part where hydrogen concentration in gas introduced is high can also constitute the above-mentioned catalyst body so that it may become less than other parts. Even if it does in this way, same effect of making calorific value small and preventing partial overheating of a catalyst body is acquired.

[0019] Thickness of a passage wall of the above-mentioned carrier in a part where hydrogen concentration in gas by which the above-mentioned introduction is specifically carried out like Claim 6 considering the above-mentioned catalyst body as composition which supported a catalyst to a carrier of honeycomb structure is high is made thicker than other parts. Since calorific capacity of this part becomes large and support area of a catalyst also becomes small by this, the calorific value itself can decrease and the above-mentioned effect can be acquired easily.

[0020] Or passage sectional areas of the above-mentioned carrier in a part where hydrogen concentration in gas by which the above-mentioned introduction is carried out like Claim 7 considering the above-mentioned catalyst body as composition which supported a catalyst to a carrier of honeycomb structure is high may be enlarged. Since support area of a catalyst will become small and calorific value will decrease if it does in this way, the above-mentioned effect can be acquired easily.

[0021] While providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in a device of Claim 8 in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, Hydrogen treatment capability per unit volume in a part to which hydrogen concentration in gas introduced fell rapidly constitutes the above-mentioned catalyst

body so that it may become larger than other parts.

[0022]Hydrogen concentration distribution in the above-mentioned catalyst body continues a fall gently after that, although it is the highest in a catalyst inlet part and a reaction usually progresses and decreases rapidly quickly. Then, if hydrogen concentration heightens throughput of a part which decrease in number slowly, the length of a gas flow direction of a catalyst body can be shortened, and a miniaturization can be attained. Although there is a possibility that it may be discharged while hydrogen has not fully reacted, when hydrogen begins to flow, that is, catalyst temperature is low and activity is low, in the usual throughput, aggravation of exhaust emission can be prevented by providing a high part of throughput. And at the time of regular, since it is a low part of hydrogen concentration distribution, even if it makes throughput high, reaction fever occurs more than needed and it does not become overheating. On the contrary, since a catalyst inlet part of the upstream will be activated with that radiation and heat transfer if a reaction begins to progress by this part at the time of a standup, controlling partial overheating, the whole catalyst body can be activated and it can process efficiently.

[0023]The above-mentioned catalyst body is specifically considered as composition which supported a catalyst to a carrier of honeycomb structure like Claim 9, hydrogen concentration in the above-mentioned gas introduced is making more than other parts a catalyst holding amount per unit area in a part to which it fell rapidly, and the amount of hydrogen reactions per unit area is made to increase. If it does in this way, the length of a gas flow direction of a catalyst body required even for a predetermined level to reduce hydrogen concentration is shortened, and it can miniaturize. That is, after hydrogen of most in emission gas reacts at a stretch, hydrogen concentration in emission gas becomes low, a concentration gradient of gas and a catalyst surface becomes small, and also when gas carries out cubical expansion by generation of heat of hydrogen, the rate of flow increases. Then, in order that hydrogen may not carry out a deer reaction gradually, a little hydrogen quantity will come out, and nevertheless processing will take a certain considerable distance, but this is avoided by having the above-mentioned composition, and a large device is obtained in throughput by miniaturization.

[0024]Or while considering the above-mentioned catalyst body as composition which supported a catalyst to a carrier of honeycomb structure like Claim 10, it may be made for support area of a catalyst per unit volume in a part to which hydrogen concentration in gas introduced fell rapidly to become larger than other parts. Even if it does in this way, same effect is acquired, a fall of a reaction by hydrogen concentration inclination and a gas flow rate is prevented, and a device in which it is small and throughput is large can be realized.

[0025]Like Claim 11, the above-mentioned catalyst body can be constituted using a carrier of honeycomb structure of the product made from ceramics, or metal, for example. Mass production which used a mold is possible for a ceramic honeycomb carrier, and cost reduction is possible for it. Even if a metallic honeycomb carrier piles up a metaled corrugated panel and a plate, is created, and can process a corrugated panel easily with a gear gear and also it uses the same corrugated panel, since change of mountain height etc. is easy, it is easy to manufacture it and it is cheap. In a product made from ceramics, since it is necessary to roll a ceramic sheet which supports a periphery so that a crack may not arise in thermal expansion, and it is hard to produce a short carrier to a longitudinal direction, in such a case, if it is metal, it is advantageous.

[0026]In order to solve an aforementioned problem, while providing a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in a device of Claim 12 in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, the above-mentioned catalyst body is divided in the direction of a gas flow at plurality, and it is considered as construction material different, respectively. When a catalyst body using a carrier made from ceramics is arranged to the upstream and a catalyst body using metal carriers is arranged to that downstream at this time, while making moisture in gas introduced into the above-mentioned catalyst body stick to a ceramic carrier, it can be made to dry by conduction and radiation of heat which were generated in a metal carrier part.

[0027]Since a lot of steams are usually contained, moisture is absorbed by catalyst surface, and

a reaction does not progress to gas discharged from an air pole of a fuel cell during power generation, but there is a possibility that emission immediately after discharge of hydrogen may get worse in it. Then, since an inflow of moisture to the downstream is suppressed and it becomes a dry gas by using a ceramic carrier for the upstream and making moisture absorb like the above-mentioned composition, a reaction is started promptly. Since the downstream was made into a metal carrier, local overheating can be prevented from distributing heat generated rapidly throughout a carrier with sufficient heat conduction, and arising near the entrance of a metal carrier part. If a reaction is started in a metal carrier part, since it dries with heat from a metal carrier part, the ceramic carrier part which absorbed moisture can absorb enough moisture discharged from an air pole by the following hydrogen discharge.

[0028]Like Claim 13, an installed position of the above-mentioned catalyst body is good to carry out emission gas from the above-mentioned air pole in an ejection passage for [ to the atmosphere ] emitting. Discharge of hydrogen from the above-mentioned hydrogen pole is not continuous, usually sets a certain time interval, and is discharged (it is once in 10 minutes). On the other hand, from the above-mentioned air pole, since gas is always discharged, the above-mentioned catalyst body can be cooled using while hydrogen is not discharged by always contacting the above-mentioned catalyst body to this emission gas. Therefore, increase of hydrogen quantity which there is [ hydrogen quantity ] no necessity for controlling an exhaust water quantum etc. in order to avoid excessive temperature up of the above-mentioned catalyst body, and makes it burn per time is possible. By installing the above-mentioned catalyst body in an ejection passage established permanently at a fuel cell conventionally, an equipment configuration is simplified and space-saving-ization can be attained.

[0029]It is good to be in the above-mentioned ejection passage, and to carry out an installed position of the above-mentioned catalyst body near the injection hole to the atmosphere like Claim 14, suitably. Thereby, a moisture content per unit volume of gas introduced can be reduced. That is, in a fuel cell, since gas which made an inside a pressurization state and became saturated steam mostly is introduced and is burned in order to raise generation efficiency, gas containing a lot of steams is discharged. In an ejection passage, a pressure of gas becomes low, and it can introduce into the above-mentioned catalyst body in the near state in a businesslike manner, and becomes difficult to solidify moisture on a catalyst surface from there being many moisture contents which can be held as a gas, so that it is close to an exit. Therefore, a collision opportunity of a catalyst and a steam is reduced and time to a combustion start of a catalyst can be shortened.

[0030]In order to process hydrogen with a device provided with a catalyst body which makes emission gas which contains oxygen discharged from the above-mentioned air pole side like Claim 15 susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out, specifically, An opening and closing means which opens and closes a hydrogen ejection passage and the above-mentioned hydrogen ejection passage for leading emission gas containing hydrogen discharged from the above-mentioned hydrogen pole side to the above-mentioned catalyst body, and a control means which introduces into the above-mentioned catalyst body emission gas which controls opening and closing of the above-mentioned opening and closing means, opens the above-mentioned hydrogen ejection passage wide periodically, and contains the above-mentioned hydrogen are established. This control means performs control which introduces emission gas which repeats opening and closing of the above-mentioned opening and closing means for a short time, and contains the above-mentioned hydrogen intermittently during a pre-heating period of the above-mentioned catalyst body.

[0031]When introducing into the above-mentioned catalyst body emission gas which opens the above-mentioned hydrogen ejection passage wide periodically, and contains the above-mentioned hydrogen, in order to activate a catalyst, control which introduces a small amount of hydrogen, makes it activated, and discharges hydrogen of a stipulated amount after that first is considered easily, but. Reaction sufficient in this for a catalyst to which it is exposed to a steam and activity is falling cannot be occurred, but emission gets worse. On the other hand, when a constant rate of some hydrogen is discharged very much for a short time, in order that a part of catalyzed combustion may break out, a part of supplied hydrogen is purified. If hydrogen of the

specified quantity is discharged after repeating this two or more times, a catalyst can be used in high activity from the first stage, and it can prevent suppressing emission low.

[0032]A device of Claim 16 is a device for processing emission gas containing hydrogen discharged from the hydrogen pole side of a fuel cell, and is provided with a catalyst body which makes emission gas containing oxygen discharged from the above-mentioned air pole side in emission gas containing the above-mentioned hydrogen susceptibility-of-substances-to-burn gas and to which catalyzed combustion is carried out. In this device, it was considered as structure which divides and introduces into it emission gas containing the above-mentioned hydrogen at two or more places of a gas flow direction of the above-mentioned catalyst body so that it may become the calorific value of a request of this passage of each part of the above-mentioned catalyst body while establishing a passage for introducing emission gas containing the above-mentioned hydrogen in the above-mentioned catalyst body.

[0033]In the above-mentioned composition, instead of changing structure of the above-mentioned catalyst body, structure of a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body is changed so that each part of the above-mentioned catalyst body may serve as desired calorific value. Since it can adjust with hydrogen quantity introduced, if calorific value of each part of the above-mentioned catalyst body carries out division supply of the emission gas containing the above-mentioned hydrogen to each part and each amount of supply is adjusted, it can prevent a local rise in heat and can process hydrogen efficiently safely with simple composition.

[0034]A device of Claim 17 provides two or more fork roads which divide and introduce into it emission gas containing the above-mentioned hydrogen at this passage at two or more places of a gas flow direction of the above-mentioned catalyst body while establishing a passage for introducing emission gas containing the above-mentioned hydrogen in the above-mentioned catalyst body. And a fork road of these plurality is constituted so that each part of the corresponding above-mentioned catalyst body may serve as desired calorific value.

[0035]If emission gas containing the above-mentioned hydrogen is specifically introduced into each part of the above-mentioned catalyst body from two or more above-mentioned fork roads, a gas mass flow introduced into each part of the above-mentioned catalyst body can be adjusted by changing shape of each fork road, etc. Therefore, it can be considered as calorific value of a request of each part of the above-mentioned catalyst body, a local rise in heat etc. can be prevented, and it can be safely considered as an efficient hydrogen treatment device.

[0036]A device of Claim 18 provides a passage for introducing emission gas which contains the above-mentioned hydrogen in the above-mentioned catalyst body, and provides two or more fork roads which divide and introduce emission gas which contains the above-mentioned hydrogen in two or more places of a gas flow direction of the above-mentioned catalyst body at this passage. Let a fork road of these plurality be the structure where emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream is introduced.

[0037]Since gas having contained many steams is discharged at the time of the usual power generation, a catalyst surface gets wet and a reaction becomes difficult to occur, but. By having passage composition into which emission gas which contains much above-mentioned hydrogen by the upstream of the above-mentioned catalyst body is introduced, it is made to generate heat intensively in an upstream catalyst body, and a catalyst can be activated promptly. Although it becomes gas with few water vapor contents with high hydrogen concentration at the time of a power generation stop and starting, since gas is introduced also into a catalyst body of the downstream by two or more above-mentioned fork roads, it is made to generate heat by the whole catalyst body, and it becomes possible to perform processing with sufficient safety and efficiency.

[0038]Specifically like Claim 19, a passage sectional area of two or more above-mentioned fork roads is changed. For example, a passage sectional area of a fork road corresponding to the upstream of the above-mentioned catalyst body is enlarged, ventilation resistance is made small, and emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream can be introduced.



[0039]Or like Claim 20, it is provided in an end of two or more above-mentioned fork roads, and an effective area product or number of feed ports for introducing into each part of the above-mentioned catalyst body emission gas containing the above-mentioned hydrogen can also be changed. For example, since gas volume introduced will increase greatly an effective area product of the above-mentioned feed port if a number is increased, emission gas which contains much above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body rather than the downstream can be introduced.

[0040]A passage switching means which controls by composition of the above-mentioned paragraph 21 an inflow of emission gas containing the above-mentioned hydrogen to two or more above-mentioned fork roads is established. and emission gas which contains the above-mentioned hydrogen in the upstream of a gas flow direction of the above-mentioned catalyst body at the time of power generation of a fuel cell -- a channel change being performed and at the time of a power generation stop or starting so that the whole quantity may be introduced mostly. It is characterized by performing a channel change so that emission gas which contains the above-mentioned hydrogen also in the downstream of a gas flow direction of the above-mentioned catalyst body may be introduced.

[0041]emission gas which gas having contained many steams is discharged at the time of power generation, opens only a fork road which introduces gas into the upstream of the above-mentioned catalyst body, for example since temperature of a catalyst body does not rise as easily as dry gas, and contains the above-mentioned hydrogen -- the whole quantity can be mostly supplied to an upstream part, and temperature can be raised promptly. On the other hand, at the time of a power generation stop and starting, since [ that hydrogen concentration is high ] there are few water vapor contents, if it also opens a fork road which introduces gas into the downstream of the above-mentioned catalyst body and is made to generate heat by the whole catalyst body, it can process efficiently more safely.

[0042]In composition of the above-mentioned paragraph 22, a vapor-liquid-separation member which becomes a front face of a gas flow direction of the above-mentioned catalyst body from a foam metal is provided. Since specific surface area is dramatically large, on the surface, the foam metal can make moisture in emission gas able to condense positively, and can be removed. Since moisture in emission gas will condense within the above-mentioned catalyst body and a catalyst surface will not be wet if it does in this way, catalytic reaction is promoted and efficient processing is attained.

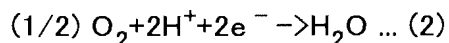
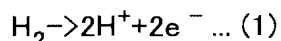
[0043]In composition of the above-mentioned paragraph 23, a wrap shielding member is provided for a part where the water of condensation exists in a front face of a gas flow direction of the above-mentioned vapor-liquid-separation member easily. Since a pickpocket omission will arise if gas containing hydrogen flows into a part to which a catalyst got wet with the water of condensation, by providing a vapor-liquid-separation member so that a water-of-condensation ball and a cone part may be covered, a pickpocket omission can be prevented and hydrogen can be processed certainly.

[0044]

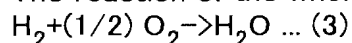
[Embodiment of the Invention]Hereafter, Drawings explain a 1st embodiment of this invention. It is a figure in which drawing 1 shows the outline composition of the fuel cell system for cars, and the exhaust water matter processing unit 2 with which it was connected and the air supply means 31 of an air pump etc. and the hydrogen storage means 32 of a high voltage compressed water matter tank etc. equipped the ejection passage 4 with the catalyst body 22 is installed by the fuel cell 1. The air pole (anode) 13 which formed the fuel cell 1 in the solid polyelectrolyte membrane 12 and the surface of one of these, It has the unit cell 11 which consists of the hydrogen pole (negative pole) 14 provided on the surface of another side as the principal part, and is constituted by laminating a large number via the separator (figure abbreviation) in which the slot used as a gas passageway was formed on the surface which touches an electrode in this unit cell 11. The silencer 5 is installed in the upstream of the exhaust water matter processing unit 2.

[0045]The proton conductivity solid polyelectrolyte membrane of a fluoro-resin system is used for the solid polyelectrolyte membrane 12, for example. The material which combines

conductivity and gas permeation nature, for example, carbon crossing, carbon paper, etc., is used for the air pole 13 and the hydrogen pole 14, and they can also be made to support the catalyst for promoting an electrode reaction. Similarly the hydrogen which the oxygen used by the air pole 13 is supplied as application-of-pressure air from the air supply means 31, and is used in the hydrogen pole 14 is supplied to the fuel cell 1 in the state of pressurized gas from the hydrogen storage means 32. At this time, when a hydrogen ion generates by the electrode reaction shown in a following formula (1), electrons are emitted, and when that electron moves to the air pole 13 side, it generates electricity in the hydrogen pole 14. A hydrogen ion passes along the inside of the polymer electrolyte membrane 12, and reaches the air pole 13, and water generates it by the electrode reaction shown in a following formula (2).



The reaction of the whole cell becomes like a formula (3).



[0046] Here, like the above-mentioned formula (1), it is decomposed into ion in the hydrogen pole 14, and hydrogen diffuses the inside of the solid polyelectrolyte membrane 12 to the air pole 13 side. Therefore, the emission gas from the hydrogen pole 14 a theory top, It becomes only hydrogen gas of the surplus which was not used by an electrode reaction, and this is circulated from the hydrogen storage means 32 to a hydrogen supply course using the hydrogen circulation means 33, such as a pump, and power generation should be able to be continued if the hydrogen to have been used in the hydrogen pole 14 considers it as the system made to newly supply. However, if operation which uses the hydrogen circulation means 33 and circulates hydrogen is actually continued in order that nitrogen and produced water by the side of the air pole 13 may flow into the hydrogen pole 14 side through the solid polyelectrolyte membrane 12, the hydrogen concentration by the side of the hydrogen pole 14 will fall with a previous impurity. Then, in order to maintain hydrogen concentration more than fixed, hydrogen substitution which discharges the gas by the side of the hydrogen pole 14 periodically, and introduces hydrogen is performed.

[0047] The hydrogen ejection passage 41 which connects the hydrogen circulation means 33 and the ejection passage 4 is specifically formed, and the opening and closing means 34 of an electro-magnetic valve etc. is installed in this hydrogen ejection passage 41. Opening and closing of the hydrogen ejection passage 41 by an opening and closing means can be controlled using the control means 35, for example, open the hydrogen ejection passage 41 wide for several seconds once in [ in 10 minutes ], and discharge the emission gas containing hydrogen to the ejection passage 4. The details of the control at the time of this periodical hydrogen discharge are mentioned later. It is a passage for emitting to the atmosphere the emission gas containing the oxygen discharged from the air pole 13 side, and by this invention, the ejection passage 4 is introduced into the exhaust water matter processing unit 2 by making into susceptibility-of-substances-to-burn gas the emission gas containing this oxygen, and after carrying out catalyzed combustion of the emission gas containing hydrogen and reducing hydrogen concentration enough, it is discharged. Since the emission gas containing the oxygen discharged from the air pole 13 side is always discharged during operation, the catalyst body 22 in the exhaust water matter processing unit 2 which became an elevated temperature by generation of heat by discharge of hydrogen is cooled to gas temperature by the following hydrogen discharge.

[0048] As shown in a figure, when forming the silencer 5, it is desirable to arrange the exhaust water matter processing unit 2 to the downstream of the silencer 5. This is to become low-pressure power and for the moisture content per unit volume of gas to decrease so that the inside of the ejection passage 4 is close to the injection hole like the downstream (i.e., the atmosphere). By this invention, although common burners, such as a burner, are arranged from viewpoints of a noise reduction etc. at the upstream of the silencer 5 in many cases, in order to carry out catalyzed combustion at low temperature comparatively, they are the purposes of avoiding the temperature fall by generating of the water of condensation, etc., and are installed in the above-mentioned position. By installing the silencer 5 in the upstream, the emission gas

containing hydrogen and the emission gas containing oxygen are mixed good within the silencer 5, are introduced in the exhaust water matter processing unit 2, and also have an advantage which raises combustor efficiency.

[0049]The exhaust water matter processing unit 2 allocates the catalyst body 22 for carrying out catalyzed combustion of the hydrogen in the cylindrical container 21. The upstream catalyst object 201 in which the catalyst body 22 is located in the upstream of a gas flow as details are shown in drawing 2. It is divided by the downstream catalyst object 202 located in the downstream, and these catalyst bodies 201 and 202 support a catalyst to the carrier of the honeycomb structure which has a passage of a large number parallel to the flow direction of gas, and are formed in it by each. Here, in this embodiment, the passage wall 211 of the upstream catalyst object 201 forms so that it may become thicker than the passage wall 212 of the downstream catalyst object 202. The cross-section area of the passage of the upstream catalyst object 201 and the passage of the downstream catalyst object 202 and the catalyst holding amount per unit area presuppose that it is the same.

[0050]At this time, as for the upstream catalyst object 201 which thickened wall thickness, the calorific capacity per unit area becomes larger than the downstream catalyst object 202. On the other hand, as for the heat generation surface product per unit volume, i.e., the support area of a catalyst, since the surface area of each passage will become small if wall thickness is thick, the direction of the upstream catalyst object 201 becomes smaller than the downstream catalyst object 202. Although the hydrogen concentration in the emission gas introduced into the catalyst body 22 is the highest in the upstream end near an entrance, therefore calorific value also increases easily, by this embodiment, calorific capacity of this portion is enlarged, and since heat was made easy to absorb, excessive temperature up is prevented. Since support area (holding amount) of the catalyst was made small, the heat itself to generate becomes small.

[0051]The longitudinal direction length of the upstream catalyst object 201 and the downstream catalyst object 202 sets up as follows. Generally, the hydrogen concentration distribution in the catalyst body 22 is the highest at an inlet section, and after a reaction progresses and decreases rapidly quickly, it continues a fall gently. That is, when the wall thickness of a catalyst body is constant, as a dotted line shows to drawing 3, hydrogen contacts a catalyst by the upstream (field shown in a figure by x) of the catalyst body 22, a reaction progresses quickly, and catalyst body 22 temperature also rises abruptly (when wall thickness of the upstream catalyst object 201 is not thickened), but. Subsequently, catalyst body 22 temperature also decreases rapidly with reduction in hydrogen concentration. In the downstream (field shown in a figure by y) of the catalyst body 22, like hydrogen concentration, temperature falls gently and it becomes target temperature mostly in the distance y. Then, like drawing 2, it is made to correspond to these [ x and y ], and length [ of the longitudinal direction of the upstream catalyst object 201 and the downstream catalyst object 202 ] x and y are set up. By carrying out like this, gas with high concentration continues being supplied and it becomes possible to suppress low the temperature of the field x where catalyst body temperature is comparatively high.

[0052]In manufacturing the catalyst body 22 of the above-mentioned structure, first ceramics, such as zirconia, by the usual method die forming and by calcinating, producing the carrier of specified shape and being immersed in a catalyst solution, It is made to stick and what is necessary is just to unify, after manufacturing the upstream catalyst object 201 and the downstream catalyst object 202 to a different body, respectively. Although ceramic carriers, such as zirconia, have an advantage which shaping is easy and tends to mass-produce, not only this but metal carriers for example, can also be used for the construction material of a carrier. The metal carrier cannot contain moisture easily, and since heat conduction is good, it can do concentration distribution few.

[0053]The operation of this embodiment is explained below. From the air supply means 31, it will react, as shown in the above-mentioned formula (1) and (2), and air will be generated to it, if hydrogen is supplied from the hydrogen storage means 32 to the fuel cell 1 of drawing 1. The hydrogen supplied from the hydrogen storage means 32 circulates by the circulation means 33, and only the hydrogen quantity consumed by real power generation is supplied from the hydrogen storage means 32. However, since it becomes impossible to use it for power generation

while circulating when nitrogen and a steam mix from the air pole 13, hydrogen concentration falls and below fixed concentration becomes, the opening and closing means 34 is opened, it discharges from the hydrogen ejection passage 41 to the ejection passage 4, catalyzed combustion is carried out within the exhaust water matter processing unit 2, and it is considered as clean gas.

[0054]The hydrogen introduced into the catalyst body 22 burns considering the gas containing the oxygen discharged from the air pole 13 as susceptibility-of-substances-to-burn gas. Here, as mentioned above, generally the hydrogen concentration distribution in the catalyst body 22 is the highest at an inlet section, and a reaction progresses and carries out a rise in heat quickly, but the catalyst body 22 makes wall thickness of the upstream catalyst object 201 thicker than the downstream catalyst object 202, and since calorific capacity is large, it tends to absorb heat. Since catalyst support area is small, the calorific value itself can be controlled.

[0055]Although the calorific capacity of a catalyst body seldom influences at the time of steady operation, when the gas which contains hydrogen like this device is supplied intermittently and accompanied by big generation of heat for a short time, it can control excessive generation of heat by using the upstream catalyst object 201 of the catalyst body 22 as a heat-absorptive object. While the upstream catalyst object 201 with thick wall thickness absorbs heat compared with the case where the effect is clear to drawing 3, and wall thickness is constant, when a heat generation surface product becomes small, the rise of catalyst body temperature becomes small and the maximum temperature is falling greatly. Since the hydrogen which did not react with the upstream catalyst object 201 burns, if it enters in the downstream catalyst object 202, it goes up again, and after that, catalyst body temperature will fall and will turn into the degree of about 1 constant temperature.

[0056]Thus, according to the above-mentioned composition, catalyzed combustion can be effectively carried out by the catalyst body 22 whole, controlling an excessive rise in heat, and exhaust water matter can be processed safely and efficiently. Since the exhaust water matter processing unit 2 was installed in the ejection passage 4 of the air pole 13, it is not necessary to form the new device for susceptibility-of-substances-to-burn gas supply, composition is simplified, and cost can be reduced.

[0057]Catalyst body 22 composition in a 2nd embodiment of this invention is shown in drawing 4. Although a 1st embodiment of the above showed the composition which controls the rise in heat paying attention to the point that the upstream catalyst object 201 serves as overheating easily, According to this embodiment, like drawing 4 (a), the catalyst holding amount per unit area of the downstream catalyst object 202 is made more than the upstream catalyst object 201, the combustor efficiency of the downstream catalyst object 202 is raised, and the miniaturization of the catalyst body 22 is attained. The upstream catalyst object 201 and the downstream catalyst object 202 are formed in one using the carrier of the same structure, and are the same. [ of passage sectional areas and wall thickness ]

[0058]In order to change a catalyst holding amount with the upstream catalyst object 201 and the downstream catalyst object 202 using the same carrier, catalyst concentration -- differing -- two -- a kind -- a catalyst solution -- preparing -- a carrier -- one side -- the end face -- from -- length -- x -- a portion -- low concentration -- a catalyst solution -- being immersed -- an upstream catalyst -- the body -- 201 -- carrying out -- while -- remaining -- length -- y -- ' -- a portion -- another side -- the end face -- a side -- from -- high concentration -- a catalyst solution -- being immersed -- a downstream catalyst -- the body -- 202 -- carrying out -- \*\*\*\*ing .

[0059]Generally, as shown in drawing 5 (b), the hydrogen concentration in the catalyst body 22 is the highest at an inlet section, a reaction progresses quickly and it decreases rapidly by the distance x, after that, continues a fall gently and turns into almost predetermined low concentration in the distance y. That is, when the catalyst holding amount per unit area of the upstream catalyst object 201 and the downstream catalyst object 202 is the same, in order for below prescribed concentration to carry out hydrogen concentration, it is necessary to make the longitudinal direction length of the downstream catalyst object 202 into the length corresponding to the distance y, and the physique becomes large (drawing 5 (a)).

[0060]On the other hand, in this embodiment, there are many catalyst holding amounts of the downstream catalyst object 202, and since reactivity increases and temperature also rises easily, the amount of catalyzed combustion increases. Therefore, since hydrogen concentration can be made low enough and the length of the downstream catalyst object 202 can be shortened that much in distance  $y'$  shorter than the distance  $y$  like drawing 4 (b), the catalyst body 22 is made compact, and it is small and can be considered as the high device of throughput. By having heightened the throughput of the downstream catalyst object 202, hydrogen can begin to flow, that is, even when catalyst temperature is low and activity is low, the reaction of hydrogen can progress, and aggravation of emission can be prevented. And since the hydrogen concentration distribution at the time of regular is low, even if the downstream catalyst object 202 makes throughput high, reaction fever occurs more than needed and it does not serve as overheating. On the contrary, since the catalyst inlet part of the upstream will be activated with that radiation and heat transfer if a reaction begins to progress by this part at the time of a standup, controlling partial overheating, the whole catalyst body can be activated and it can process efficiently.

[0061]Catalyst body 22 composition in a 3rd embodiment of this invention is shown in drawing 6. The upstream catalyst object 201 and the downstream catalyst object 202 are constituted from this embodiment using the carrier from which structure differs, and like drawing 6 (a), passage sectional areas are smaller than the upstream catalyst object 201, and let the carrier of the downstream catalyst object 202 be the carrier which also formed wall thickness thinly. The catalyst holding amount per unit area presupposes that it is the same with the upstream catalyst object 201 and the downstream catalyst object 202.

[0062]Since catalyst body temperature becomes high easily since the downstream catalyst object 202 of calorific capacity with thin wall thickness is small according to the above-mentioned composition, and a reaction constant becomes large, a throughput increases. Passage sectional areas are small and that the heat generation surface product per unit volume (catalyst support area) becomes large also contributes to the increase in the amount of catalyzed combustion. Therefore, like a 2nd embodiment of the above, can shorten the length of the longitudinal direction of the downstream catalyst object 202 with  $y'$ , and at the time of a standup. While the reaction of hydrogen progresses with the downstream catalyst object 202 and preventing aggravation of emission, the effect which promotes activation of the upstream catalyst object 201 is acquired.

[0063]Catalyst body 22 composition in a 4th embodiment of this invention is shown in drawing 7. The upstream catalyst object 201 and the downstream catalyst object 202 are constituted from this embodiment using the carrier from which structure differs, like drawing 7 (a), ceramic carriers, such as zirconia, are used for the upstream catalyst object 201, and a metal carrier is used for the downstream catalyst object 202. Even if \*\*\*\*\* which constitutes the downstream catalyst object 202 laminates in piles the plate 23 and the corrugated panel 24 which consist of metallic foils like drawing 7 (b), it rolls and carries out the time of what was piled up, and is good also as honeycomb shape. The downstream catalyst object 202 using a metal carrier has wall thickness thinner than the upstream catalyst object 201, and it is formed so that passage sectional areas may become small.

[0064]Rather than a ceramic carrier, since calorific capacity per unit volume can be made small, and it will be activable at an early stage and also a metal carrier will contact only gas with thin hydrogen concentration at the time of stationary burning also after the catalyst body 22 in early stages of operation has become wet if this is used for the downstream catalyst object 202, it does not have fear of overheating. On the other hand, since a lot of steams are usually contained in the gas discharged from the air pole of a fuel cell, moisture is absorbed by the catalyst surface and there is a possibility that a reaction may be checked in it, but. A ceramic carrier contributes to dry-ization of gas greatly, if this is used for the upstream catalyst object 201 in order for the carrier itself to absorb moisture. The absorbed moisture is dried by the conduction and radiation of heat which are generated in the metal carrier of the downstream.

[0065]Since the metal carrier can perform change of shape easily by changing the thickness of a metallic foil, the pitch of a corrugated panel, and a height of thread, when changing the calorific

capacity and catalyst support area of a carrier with the upstream catalyst object 201 and the downstream catalyst object 202, manufacture becomes easy like this invention. In a ceramic carrier, maintenance can also manufacture and install short shape in the longitudinal direction which becomes difficult easily.

[0066]Drawing 8 is an example of the opening and closing control of the opening and closing means 34 by the control means 35 at the time of discharging the emission gas from the hydrogen pole 14 from the hydrogen ejection passage 41 to the ejection passage 4. In order to hold the hydrogen concentration of the hydrogen pole 14 more than fixed, it is necessary to open the opening and closing means 34 of an electro-magnetic valve etc., and to discharge the emission gas containing hydrogen periodically (it is once in 10 minutes), so that it may illustrate. At this time, as a dashed line shows among a figure, the method of discharging the whole quantity of predetermined gas volume at once is common, but. In this method, since the comparatively high gas of hydrogen concentration flows in the exhaust water matter processing unit 2 which the catalyst body 22 is not activating, the exhaust water matter concentration of a starting initial will exceed a desired value temporarily. After activation, the amount of catalyzed combustion increases and the catalyst body 22 serves as an elevated temperature easily.

[0067]For this reason, as a solid line shows among a figure, the control means 35 performs control which repeats opening and closing of the opening and closing means 34 for a short time, and hydrogen which is a grade which a catalyst activates is intermittently introduced in the exhaust water matter processing unit 2 during the pre-heating period of the catalyst body 22. Thus, a catalyst is effectively activable, while the catalyst surface which became wet with the steam is dried, it is activated in an instant and the exhaust water matter of a starting initial is stopped lower than a desired value by introducing to some extent high-concentration hydrogen gas for a short time very much. If the remaining hydrogen is discharged after the suitable number of times repeating this, catalyzed combustion can be performed efficiently and the device which was excellent in exhaust emission will be realized.

[0068]Thus, according to this invention, the simple and highly efficient exhaust water matter processing unit using the emission gas from the air pole 13 is realizable. The catalyst body 22 is using the comparatively high carrier of calorific capacity for the part to which overheating occurs easily, or changing a catalyst holding amount and a heat generation surface product, and cancels overheating easily, Or in the part in which hydrogen concentration and catalyst temperature are low, and hydrogen treatment efficiency is usually low, the miniaturization of the catalyst body 22 is enabled by increasing a catalyst holding amount and a heat generation surface product as composition which heightened throughput. Aggravation of the emission at the time of a standup and overheating can be prevented by optimizing the control method.

[0069]Even if it uses independently the composition and the control method of the upstream catalyst object 201 and the downstream catalyst object 202 which were shown by each above-mentioned embodiment, respectively, they may combine some according to the purpose and can perform still better exhaust water matter processing.

[0070]Although the hydrogen ejection passage 41 from the hydrogen circulation means 33 was connected to the ejection passage 4 of the exhaust water matter processing unit 2 upper stream and the emission gas containing hydrogen was introduced into the front face of the catalyst body 22 in each above-mentioned embodiment, The hydrogen ejection passage 41 is branched and it may be made to introduce into two or more parts of the catalyst body 22 the emission gas containing hydrogen, and it depends according to operational status and suitable processing is attained. The example is shown below.

[0071]Drawing 9 is the outline composition of the fuel cell system in a 5th embodiment of this invention. In this embodiment, the valve 37 is provided in the fuel cell system shown in above-mentioned drawing 1 in the middle of the passage reached [ from the hydrogen pole 14 ] to the hydrogen circulation means 33 in the valve 36 in the middle of the passage reached [ from the hydrogen storage means 32 ] to the fuel cell 1, respectively so that it may illustrate. Thereby, when power generation is suspended, the valves 36 and 37 are closed, hydrogen is shut up in the fuel cell 1, and it becomes possible to avoid leakage and consumption of hydrogen from the hydrogen pole 14 side. However, the inside of the fuel cell 1 under power generation is a

pressurization state, and since the air pole 13 side becomes atmospheric pressure soon after a stop to this, the mixed gas with which hydrogen moves to the air pole 13 side from the hydrogen pole 14 side according to a pressure differential, and two poles contain high-concentration hydrogen will be full. In this case, when rebooting the fuel cell 1, it will be necessary to pass hydrogen to the hydrogen pole 14 side, to pass air to the air pole 13 side, and to purge mixed gas.

[0072]So, in this embodiment, by the control means 35, after closing the valve 36 at the time of a power generation stop, the valve 37 is wide opened until the hydrogen pole 14 reaches atmospheric pressure, the opening and closing means 34 is opened, and the gas by the side of the hydrogen pole 14 is discharged to the hydrogen ejection passage 41. Thereby, the pressure differential between two poles can be canceled and mixing can be suppressed for gas to the minimum. If the hydrogen pole 14 becomes atmospheric pressure, the valve 37 and the opening and closing means 34 will be closed.

[0073]The emission gas by the side of the air pole 13 which hydrogen concentration is high and serves as susceptibility-of-substances-to-burn gas rather than the gas discharged during power generation is also few, and also [ an equivalent for an idling, and ] since the gas discharged at the time of this power generation stop does not contain the moisture generated by an electrode reaction, it is drying it. For this reason, if the whole quantity is introduced into the front face of the catalyst body 22, catalytic reaction will rise rapidly and will tend to cause overheating. By this embodiment, in order to avoid this, while trichotomizing and arranging the catalyst body 22 to a gas flow direction, the hydrogen ejection passage 41 is branched and it has composition into which the emission gas which contains hydrogen in the front face of the divided catalyst bodies 22A, 22B, and 22C from each fork roads 41A, 41B, and 41C, respectively is introduced. At this time, it is good to make it a gas introduction amount decrease more in the latter-part side where temperature becomes high in order that much gas may be supplied to the catalyst body 22A of the Mogami style from other catalyst bodies 22B and 22C and the combustion gas by the catalyst of the preceding paragraph may flow.

[0074]For example, the tube diameter of the pipe which constitutes the fork road 41A of the Mogami style is the largest, and it is made for the tube diameter of the downstream fork roads 41B and 41C to become small one by one in the composition shown in drawing 10. The path of the feed ports 42A, 42B, and 42C which carry out an opening to the end of each fork roads 41A, 41B, and 41C, and introduce gas into the catalyst bodies 22A, 22B, and 22 is made into an equal diameter here, and each number is set to one. Since the flow according to pipe inner pressure loss will blow off from a feed port if a fork road is constituted from a pipe with which tube diameters differ, much gas can be supplied for the upstream.

[0075]According to the above-mentioned composition, at the time of a power generation stop, even if dry gas with high hydrogen concentration is discharged comparatively so much for a short time, Since the gas which contains hydrogen in each of the divided catalyst bodies 22A, 22B, and 22C from the fork roads 41A, 41B, and 41C of the hydrogen ejection passage 41 is introduced, the catalyst body 22A of the Mogami style can be prevented from being overheated locally. Since the tube diameter of the fork roads 41A, 41B, and 41C is made small towards the lower stream from the upper stream like drawing 10, a gas introduction amount increases in the upstream and it was made for the downstream to decrease, when hot combustion gas flows, the catalyst bodies 22B and 22C of the downstream are not overheated. Drawing 11 shows the longitudinal direction distance of the exhaust water matter processing unit 2, and the relation of the temperature of combustion, and is made to generate heat by the catalyst body 22 whole, and catalyzed combustion of it can be carried out, preventing overheating. At the time of starting, although the gas which does not contain moisture is discharged immediately after a power generation start, overheating can be controlled similarly.

[0076]Since the gas having contained many steams is discharged at the time of the usual power generation, catalytic reaction becomes more difficult to occur than dry gas, but. Since the catalyst body 22 was constituted so that much hydrogen might be supplied by the catalyst body 22A of the Mogami style rather than other catalyst bodies 22B and 22C, it generates heat intensively by the catalyst body 22A of the Mogami style, and the purification performance which

rose and was promptly excellent in temperature is demonstrated. Thus, according to this embodiment, it can be used conveniently for all at the time during power generation of a power generation stop, catalytic reaction of the hydrogen in the emission gas with which states differ can be carried out safely and effectively, and emission can be suppressed low.

[0077]Drawing 12 and drawing 13 are other examples of the composition of the fork roads 41A, 41B, and 41C. For example, like drawing 12, when each tube diameter of the fork roads 41A, 41B, and 41C is made the same, a flow may be adjusted by changing the path or number of the feed ports 43A, 43B, and 43C which introduces the gas which contains hydrogen in the catalyst bodies 22A, 22B, and 22C. Here, the path of the feed port 43A of the catalyst body 22A of the Mogami style is made larger than other feed ports 43B and 43C. The number of the feed ports 43C of the catalyst body 22C of the lowest style is made less than other feed ports 43B and 43C. Even if it does in this way, the amount of blow off of the gas which contains hydrogen towards the lower stream from the upper stream decreases.

[0078]Or the tube diameter of the fork roads 41A, 41B, and 41C, the path of the feed ports 44A, 44B, and 44C, and a number are good like drawing 13 also as composition which presupposes that it is the same, forms the valve 6 in the hydrogen ejection passage 41 between the fork road 41A and the fork road 41B, and opens and closes the valve 6 according to operational status. That is, when processing the gas containing a steam which cannot react easily like [ at the time of the usual power generation ], the valve 6 is closed by the control means 35, and it is made for the whole quantity of the gas which contains hydrogen in the catalyst body 22A of the Mogami style from the feed port 44A of the fork road 41A to blow off. On the other hand, since it becomes gas with few water vapor contents with high hydrogen concentration immediately after a power generation stop, the control means 35 opens the valve 6 and the gas which contains hydrogen also in the catalyst bodies 22B and 22C of the downstream from the feed ports 44B and 44C of the fork roads 41B and 41C is introduced. In this composition, if form a means to detect the temperature of each catalyst bodies 22A, 22B, and 22C, that result is made to feed back and opening and closing of the valve 6 are controlled, it will become possible to perform processing in which can control the catalyst body 22 to a more uniform temperature, and it is safe for it, and efficient.

[0079]Gas temperature can be lowered locally and, moreover, moisture can be made to condense on the surface of the catalyst body 22A by supplying hydrogen gas of ordinary temperature to the catalyst body 22A mostly in the about 60–70 °C gas which has the above-mentioned composition and contains moisture. Therefore, the gas supplied to the downstream catalyst bodies 22B and 22C is dried as much as possible, and the effect to prevent can also expect that a catalyst serves as inertness.

[0080]Drawing 14 (a) and (b) shows exhaust water matter processing unit 2 composition in a 6th embodiment of this invention, and is [ the member ] close and arranges the vapor-liquid-separation member 7 which becomes a front face of the catalyst body 22 from a foam metal. The vapor-liquid-separation member 7 makes the moisture in the gas which is disc-like [ of the catalyst body 22 and an equal diameter ], is the surface of the foam metal whose specific surface area is very large, and is introduced condense positively. Caudad, the water of condensation falls and is removed by gravity. Thereby, when the catalyst body 22 has got cold, a catalyst surface gets wet with the water of condensation, and activity is prevented from falling. moreover — since a pickpocket omission will arise if the gas containing hydrogen flows into the part to which the catalyst became inertness with the water of condensation — a water-of-condensation ball — the catalyst body 22 cheap lower part — a wrap — the shielding member 8 of an approximate circle arc is allocated in the front face of the vapor-liquid-separation member 7 like. Since these vapor-liquid-separation member 7, the shielding member 8, and the catalyst body 22 of each other are arranged closely, if a reaction is started and the temperature of the catalyst body 22 rises, moisture will evaporate again and will be discharged.

[0081]The internal stoma is opening the foam metal of each other for free passage, and gas circulates besides a flow parallel to a gas flow. Therefore, since the gas containing some hydrogen flows also into the part taken up with the shield 8 of the catalyst body 22 and catalytic reaction occurs, there are few rates which make the catalyst body 22 useless, and they end, and



it becomes possible to perform a cleaning effect efficiently.

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[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.

2.\*\*\*\* shows the word which can not be translated.

3.In the drawings, any words are not translated.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1]It is a schematic diagram showing the entire configuration of the fuel cell system containing the exhaust water matter processing unit of a 1st embodiment of this invention.

[Drawing 2]It is an expansion perspective view of the catalyst body in a 1st embodiment.

[Drawing 3]It is a figure showing the longitudinal direction distance of a catalyst body, and the relation of catalyst body temperature.

[Drawing 4]It is a figure in which a 2nd embodiment is shown, (a) shows the expansion perspective view of a catalyst body, and (b) shows the longitudinal direction distance of a catalyst body, and the relation of hydrogen concentration.

[Drawing 5]It is a figure in which the case where the catalyst holding amount per unit area is set constant is shown, (a) shows the expansion perspective view of a catalyst body, and (b) shows the longitudinal direction distance of a catalyst body, and the relation of hydrogen concentration.

[Drawing 6]It is a figure in which a 3rd embodiment is shown, (a) shows the expansion perspective view of a catalyst body, and (b) shows the longitudinal direction distance of a catalyst body, and the relation of hydrogen concentration.

[Drawing 7]It is the elements on larger scale for (a) to explain the expansion perspective view of a catalyst body, and for (b) explain [ a 4th embodiment is shown, ] carrier composition.

[Drawing 8]It is a time chart for explaining the discharge method of hydrogen by a control means.

[Drawing 9]It is a schematic diagram showing the entire configuration of the fuel cell system in a 5th embodiment of this invention.

[Drawing 10]It is an expansion perspective view showing the outline composition of a catalyst body and a fork road in a 5th embodiment.

[Drawing 11]It is a figure showing the longitudinal direction distance of an exhaust water matter processing unit, and the relation of the temperature of combustion.

[Drawing 12]It is an enlarged drawing showing other examples of fork road composition.

[Drawing 13]It is an expansion perspective view showing other examples of fork road composition.

[Drawing 14]It is an enlarged drawing showing the catalyst body composition in a 6th embodiment, and (a) is a front view and (b) is a sectional view.

[Description of Notations]

1 Fuel cell

11 Unit cell

12 Electrolyte membrane

13 Air pole

14 Hydrogen pole

2 Exhaust water matter processing unit

22 Catalyst body

201 Upstream catalyst object

202 Downstream catalyst object

22A, 22B, and 22C Catalyst body  
31 Air supply means  
32 Hydrogen storage means  
33 Hydrogen circulation means  
34 Opening and closing means  
35 Control means  
36 Valve  
37 Valve  
4 Ejection passage  
41 Hydrogen ejection passage  
41A, 41B, and 41C Fork road  
5 Silencer  
6 Valve  
7 Vapor-liquid-separation member  
8 Shielding member

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[Translation done.]

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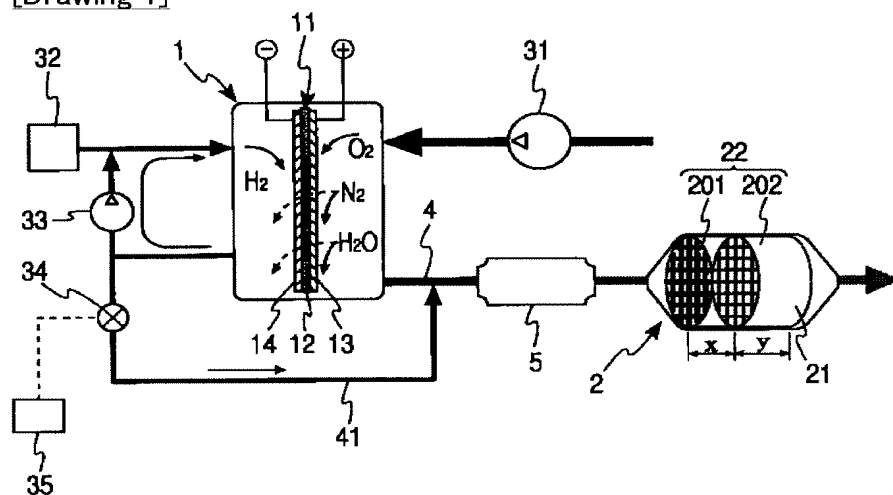
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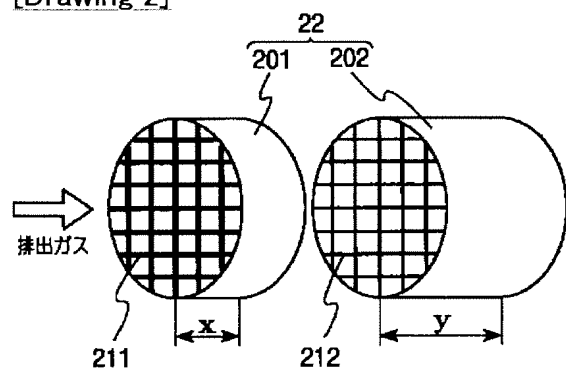
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## DRAWINGS

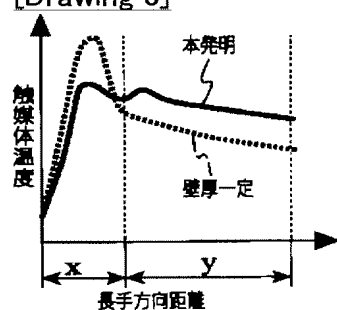
[Drawing 1]



[Drawing 2]

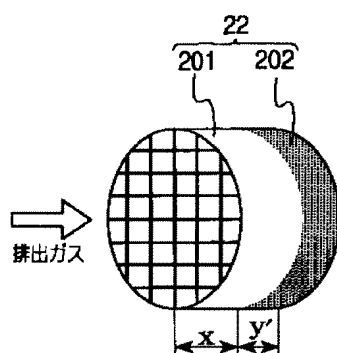


[Drawing 3]

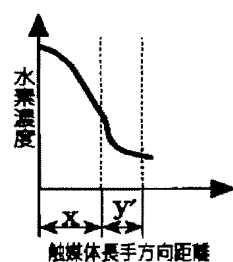


[Drawing 4]

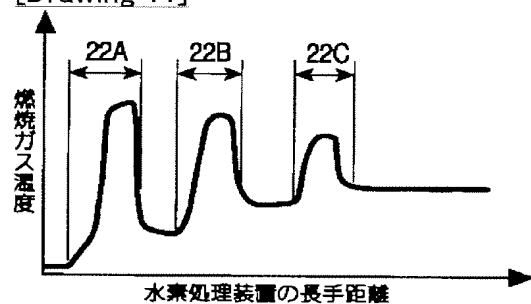
(a)



(b)

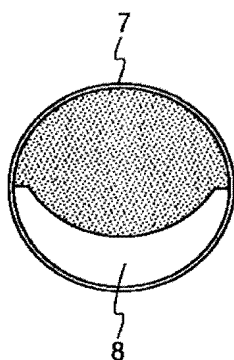


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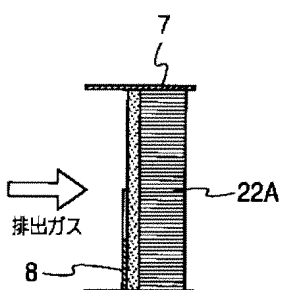


[Drawing 14]

(a)

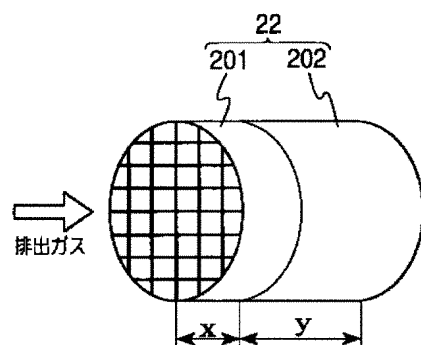


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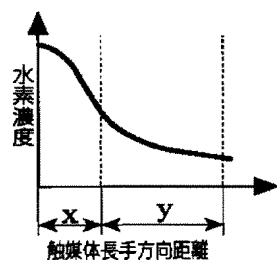


[Drawing 5]

(a)

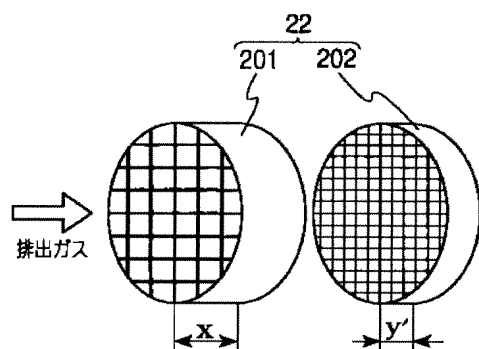


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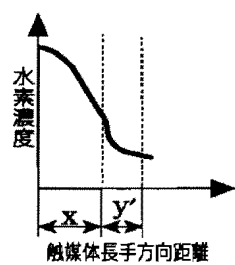


[Drawing 6]

(a)

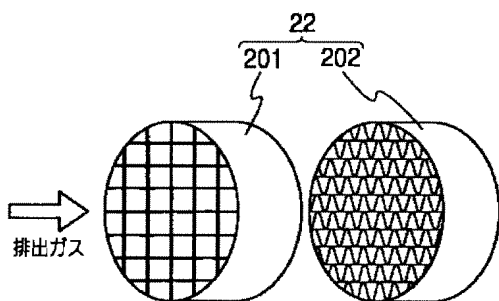


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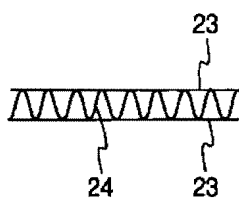


[Drawing 7]

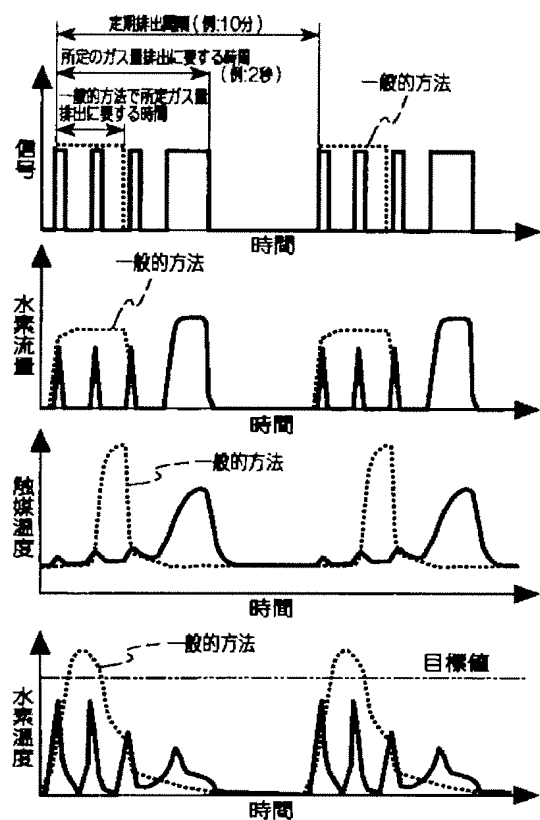
(a)



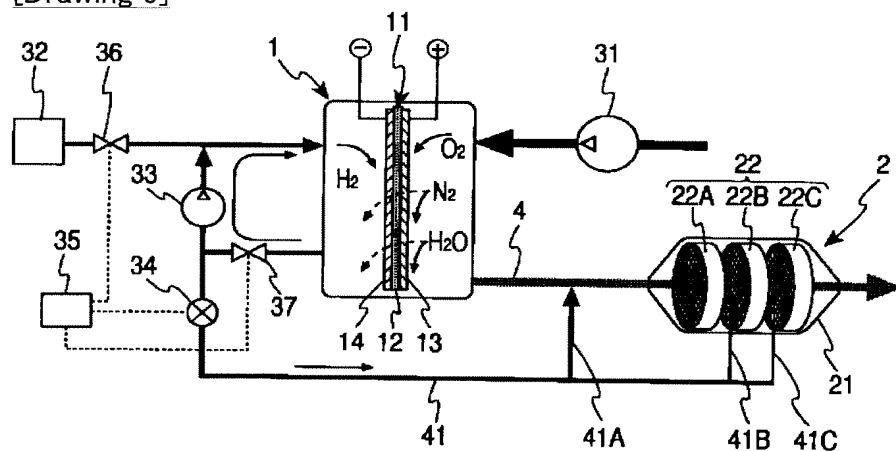
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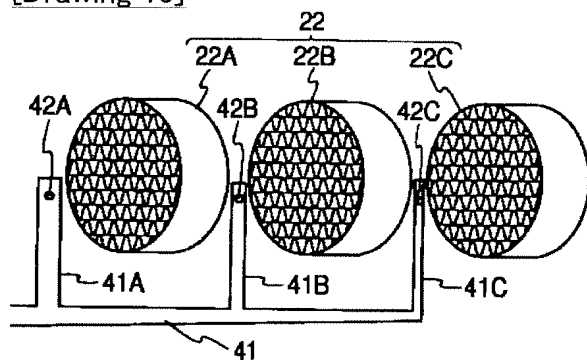
[Drawing 8]



[Drawing 9]

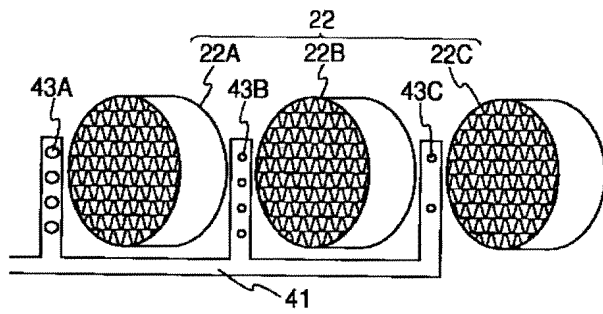


[Drawing 10]

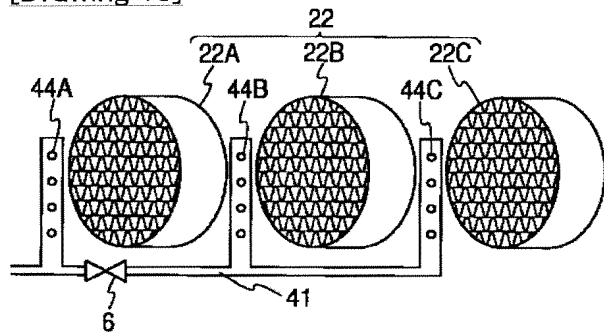


[Drawing 12]





[Drawing 13]



[Translation done.]